







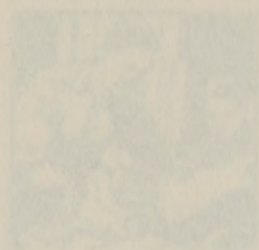
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POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA

FOR
HOME OWNER, CRAFTSMAN
AND HOBBYIST
IN TWELVE VOLUMES



Volume IV

Complete Index in Volume XII

J. F. LITTLE & IVES CO., INC. • NEW YORK

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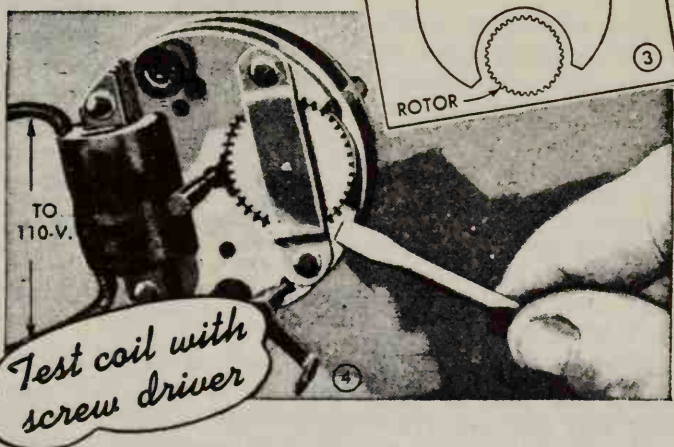
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Tricks of fixing ELECTRIC CLOCKS

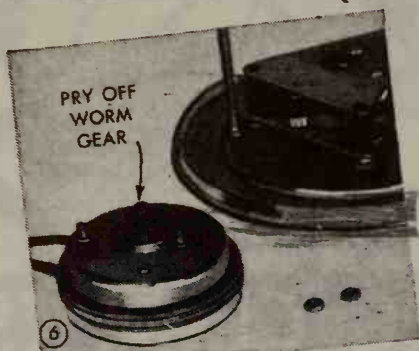
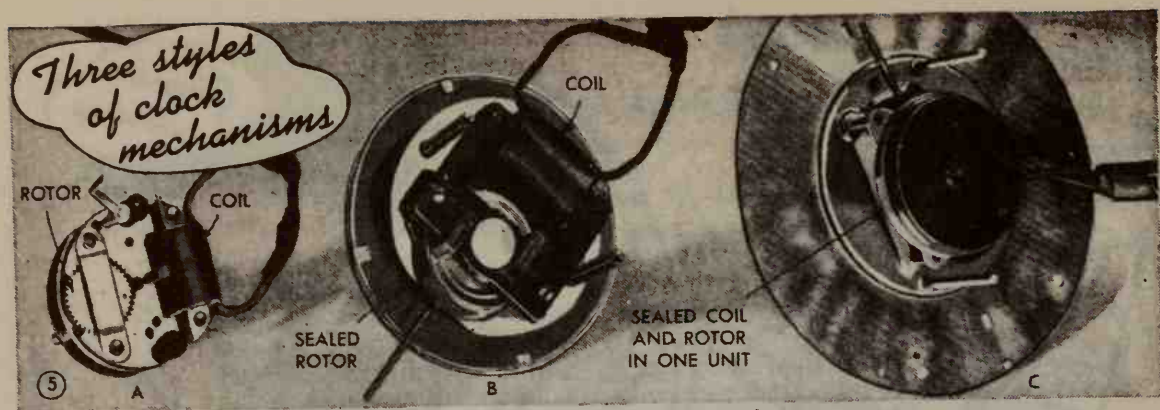
DO YOU have an electric clock that won't run? Just follow these simple steps and it's ten to one you can start the hands going again. First, dismantle the clock. This is a simple procedure, which involves taking out a couple of screws to remove the clock back or the entire mechanism from the case. It may be a simple unit like the one shown in Figs. 1 and 3, or the driving mechanism may be sealed, as those shown in details B and C of Fig. 5. At any rate, the actual operation is the same as diagrammed in Fig. 3—the current flows through the coil, setting up a magnetic field in the pole piece that causes the rotor to revolve.

Obviously, the first thing to check is the coil. Plug in at power source, then hold the clock to your ear. A faint hum indicates that the coil passes current. The coil hum is sometimes very faint and a more positive check is to touch a screwdriver to the pole piece near the rim of the rotor, as shown in Fig. 4. A gentle vibration indicates that the coil is in good condition. If the coil does not seem to pass current go over the wiring. Use any kind of electrical tester and test the current flow right up to the coil, which is easily done by using sharp test prods and sticking them into the wires near the coil, as shown in Fig. 1. If the line tests okay and if the coil is not dead, the trouble, then, must be at the rotor



or other point of the mechanism. Perhaps something is jammed.

In many cases, a dry, gummy bearing at the rotor is the source of the trouble. Clean the clock as well as you can with a small piece of cloth wrapped around a matchstick and dampened with any kind of cleaning fluid. Then, with a pointed match, carefully oil all the bearings that you can see, and the rotor shaft, as in Fig. 2. Use any good grade of nondrying, nongumming oil, such as watch oil, gun oil, etc. After this, it's probable that the clock will run. If it doesn't, check the mounting—sometimes this is rubber tubing over studs and the rubber may have deteriorated, letting the clock sag so that hands or other parts rub. Rubber mounting can be replaced with "spaghetti" tubing used in radio work. Spin the rotor of the clock with your finger



Coil repairs are usually impractical and, in sealed units, impossible. However, with the open type of coil as shown in details A and B of Fig. 5, it is worth looking into as a last resort. Split the insulation, Fig. 8, and unwind the first layer of wire. If you find a break, you can fix the coil by soldering.

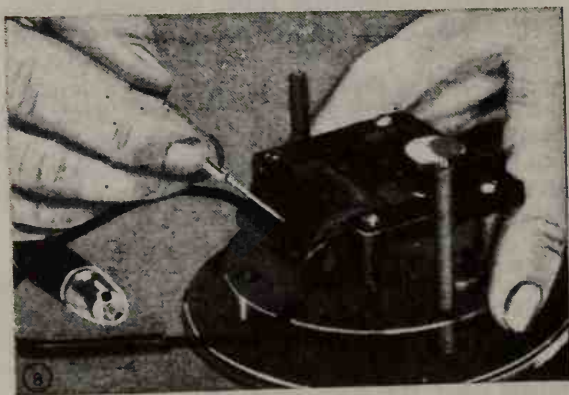
—it should revolve freely. Don't worry about end play at rotor shaft; it is made that way and centers automatically in the magnetic field when the clock is running.

If your clock has combined coil and motor like the one shown in detail C of Fig. 5, remove the whole unit by unscrewing two nuts that hold it in place. It will then look like Fig. 6. With slim pliers or other suitable tool, pry off the worm gear. The parts are shown at Fig. 7. Then the long bearing surface can be cleaned and reoiled.

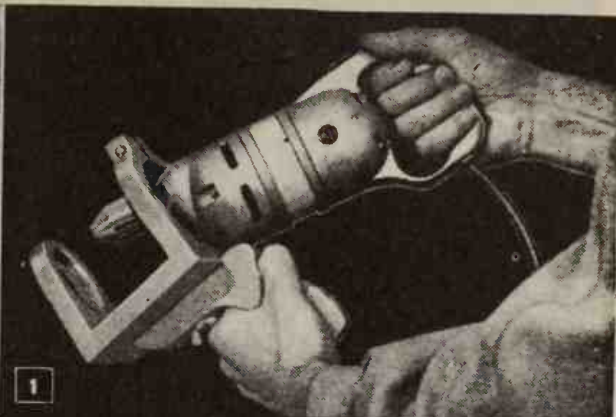
If you don't find the break in the first layer you can stop right there because invariably the break is near one end or the other. Obviously, you can't get at the inside end. The final remedy is to write the manufacturer for a quotation on a new coil. Many manufacturers will exchange rebuilt units for defective ones at a nominal charge.

Adding Life to Electric Clock

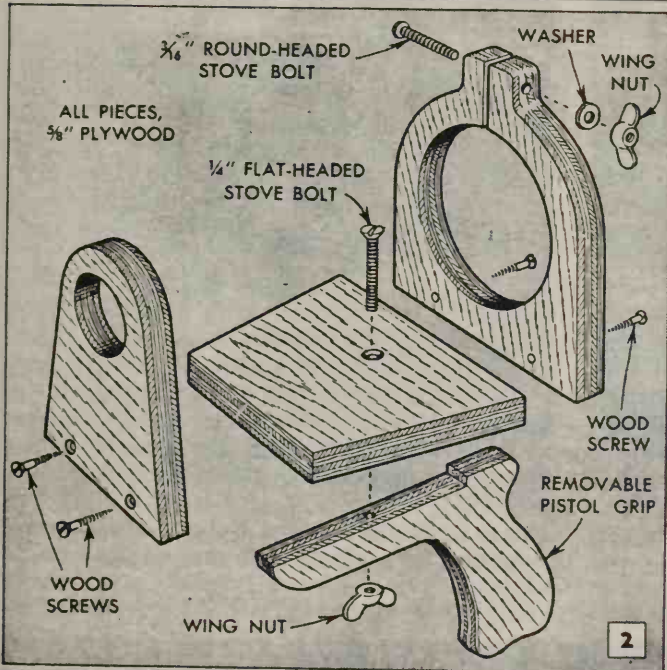
Sometimes an electric household clock stops running because the gears are worn and do not mesh properly. If this is the case, the clock can be restored for many more years of service simply by turning the works upside down and replacing them in the case in this inverted position. Before re-assembling the clock mechanism clean all visible working parts with a soft cloth slightly coated with a fine machine oil.



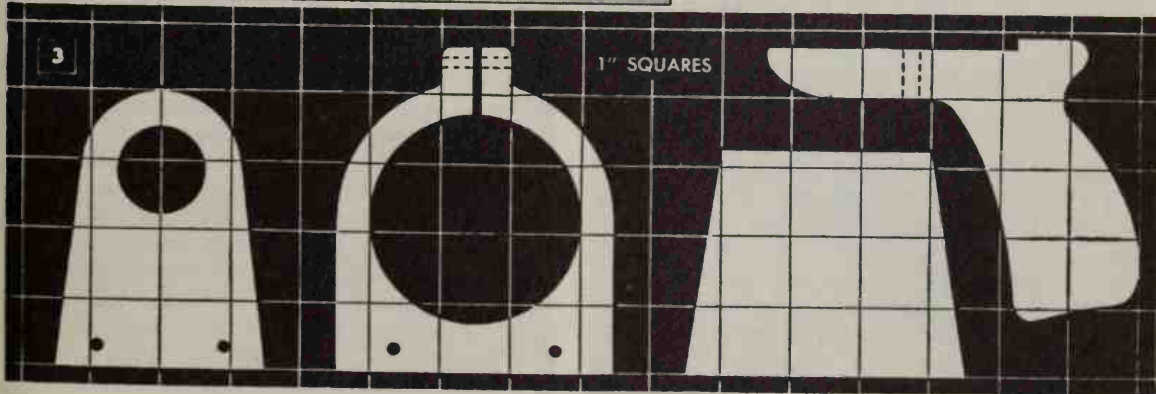
ELECTRIC-DRILL BRACKET

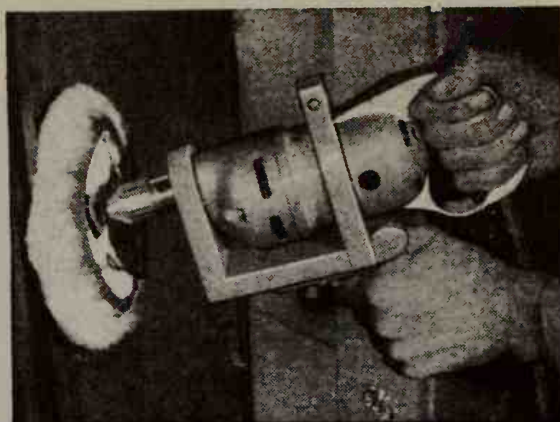
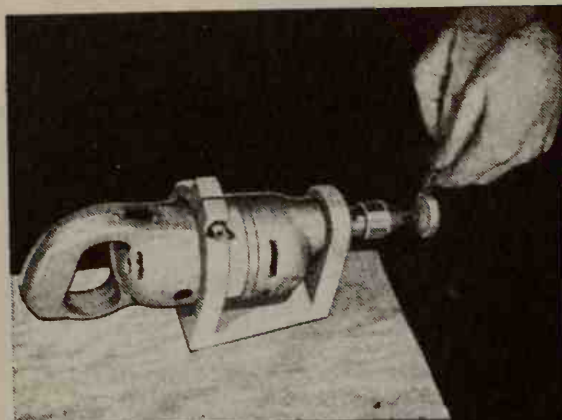


Above, the electric hand drill and bracket are assembled by inserting drill through holes in the bracket. Left, bracket fastened to adjustable arm of photo enlarger makes utility drill press. Balancing spring aids in manipulation



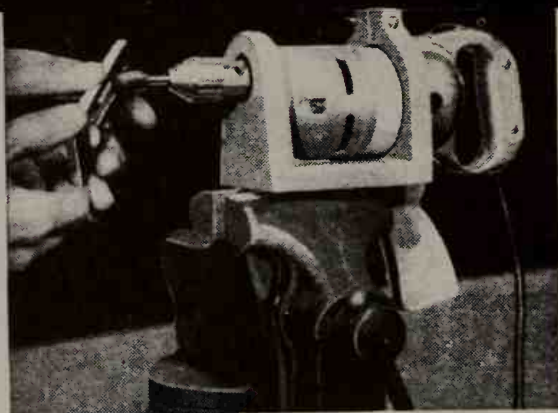
MANY attachments now available for small portable electric drills require the use of a stationary support for the drill so that the work can be held and guided with both hands. Figs. 1 to 3 inclusive and the photos on the next page show how a simple bracket for holding the drill in various work positions adds to the usefulness of this handy tool. The bracket consists of three parts, Fig. 2, with a pistol-grip piece added for two-handed operation of the drill in polishing or wire-brushing operations. Before sawing the opening in the clamping-bracket member, measure the diameter of the body of the drill just in front of the handle, then bandsaw or scrollsaw the opening slightly larger. Saw the outside to the contour given in Fig. 3 and split the





Above, with bracket handle removed, electric drill serves as portable bench grinder. Below, electric drill used as disk sander. Bracket mounted on adjustable arm of photo-enlarger stand can be set in horizontal or vertical position at any desired height

Above, bracket offers convenient two-hand control when using electric drill equipped with a buffer for polishing. Below, clamping the drill-bracket handle in bench vise will hold drill firmly when using rotary files or mounted abrasive wheels



boss at the top with two side-by-side saw cuts. Drill the split boss for a $\frac{3}{16}$ -in. stove bolt. Then drill the clamping piece and screw it to the bottom piece. Insert the drill in the clamping piece, center it, and tighten the wing nut. Place the assembly on a level surface and bring up the other supporting member against the end of the chuck. Mark a pencil line on the wood around the end of the chuck. Locate the

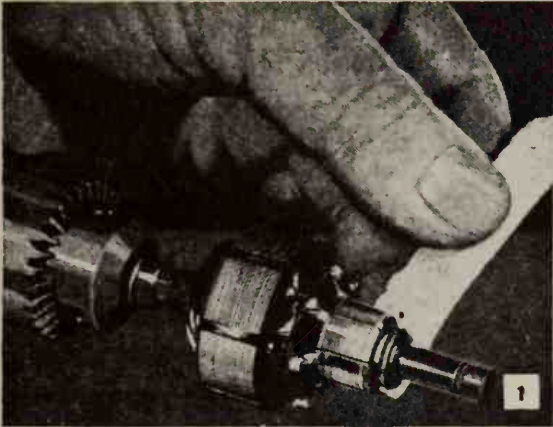
center of the circular pencil mark. Then measure the diameter of the bearing housing just back of the chuck and drill a hole in the supporting member of the same diameter as the housing. Screw this member to the base piece to complete the bracket. The pistol-grip piece is made removable by attaching it with a stove bolt and wing nut. Photo at the left of Fig. 1 shows the bracket attached to a photo-enlarger arm.

ELECTRIC FAN REPAIR

FAILURE of small electric-fan motors usually is due to four common causes—lubricant hardened or dried, bearings clogged with dust, brushes worn short and a loose connection. Any one of these can put the motor temporarily out of service. Most small fan motors can be dismantled quite easily by first removing the wire guard, the fan unit and the motor end shield. On some fan motors, it will be necessary to unsolder wire leads before the brush-holder plate can be removed.

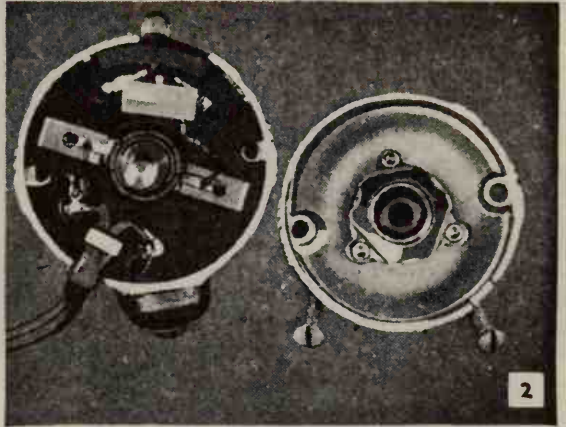
On others, this is not necessary. Fig. 2 shows a common arrangement of parts on the brush-holder plate. After removing the two screws, A in Fig. 3, work carefully in removing the end shield or damage may result. Removing the end shield generally exposes the brush-holder plate, B, the brush holders, C and D, and the resistance unit, R. Excessive wear of the brushes frequently causes the brush pigtails to jam in the holders, thus interfering with proper brush contact on the commutator. If the

brushes are so badly worn that the pigtails jam or the follower springs no longer bear on the top ends, then they should be replaced. If new brushes are not readily available, replacements can be made from common generator brushes. Mike the old brush as in Fig. 5 to get the exact size. Then cut the generator brush to these dimensions and drill for the pigtail as in Fig. 6. Drill another hole at right angles through

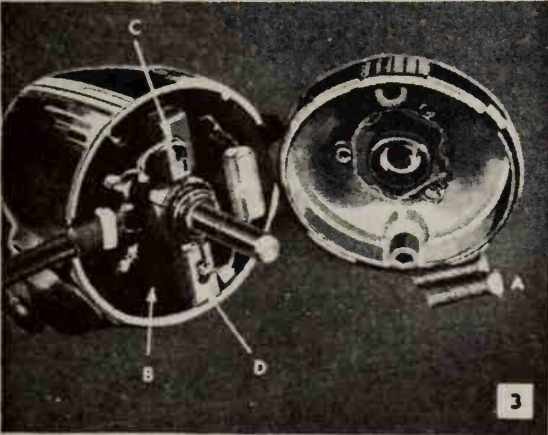


If the brush track on the commutator is badly carboned, it can be cleaned with ordinary fine sandpaper. Do not use any other abrasive for this work

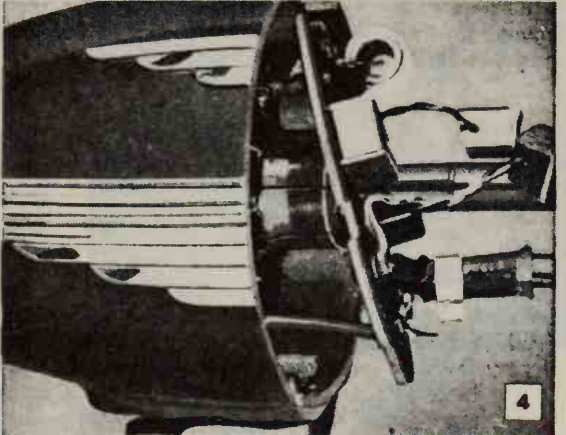
the first one and anchor the pigtail with solder. If the commutator brush track is badly carboned, it must be cleaned. Remove the holder plate, Fig. 4, and also the armature. Then mount the armature in a drill chuck, and clean and true the commutator with a piece of fine sandpaper as in Fig. 1. Clean the armature bearings with a solvent, such as kerosene, and apply new lubricant before reassembling the motor.



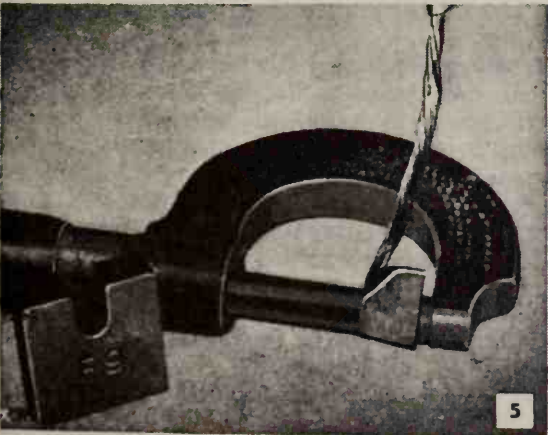
This is what you'll find inside a typical electric fan motor when the end shield is removed. On some motors, wires are unsoldered to free the brush plate



Above, a common cause of motor failure is jamming of the brush pigtails in the holders when brushes become worn. Below, replacement brushes can be made from generator brushes. Measure brush for size



Above, in most small fan motors, the brush-holder plate must be removed to free the armature. Below, attach the pigtail to replacement brush by drilling holes at right angles and then anchoring with solder





American Floor Surfacing Machine Co. photo

1

Cutting off is done easily freehand as shown above and below

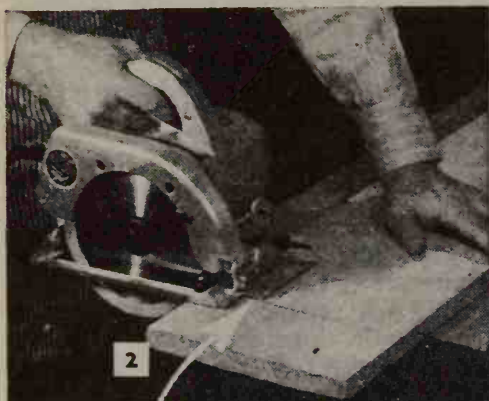
ELECTRIC HANDSAW

PORTABLE ELECTRIC saws, which have largely displaced the handsaw for cutting building materials, are now made in smaller, lighter models suitable for use in the home workshop. These units, equipped with blades ranging from 6 to 8 in. in dia., are especially handy for crosscutting long boards which are difficult to handle on small stationary saw tables.

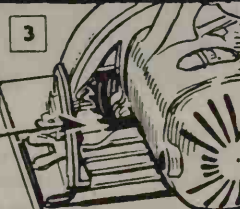
Those who contemplate building their own homes will find an electric handsaw a must for cutting framing, sheathing and roof boards accurately and speedily to the lengths and widths required. The smallest sizes having 6-in. blades will crosscut and rip 2 x 4-in. stock in a fraction of the time required for handsawing. Ordinarily, electric handsaws are used freehand, but accessory guides are available for ripping and crosscutting, also floor stands designed for converting the unit into a table saw which will do ripping, crosscutting, grooving, shaping, sanding and routing.

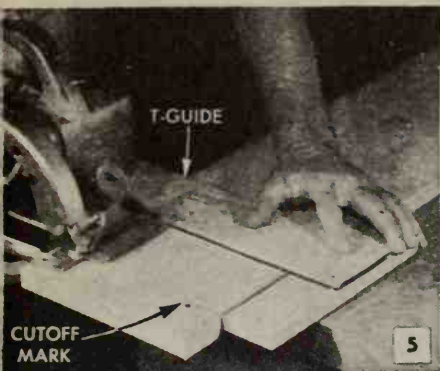
Crosscutting: To make this basic cut, the front edge of the base plate of the saw is placed on the work with the guide notch aligned with a pencil mark, Fig. 2. The blade is then started on the line or in the waste and the saw is pushed across the work, Fig. 4. Near the end of the cut, the guide notch runs off the work but you can still see the line through a window in the frame, Fig. 3.

With a right-hand saw mounting, cutting off should always be done at the right end of the work. This permits the wide portion of the base plate to rest on solid wood, as shown in Figs. 2 and 4. Fig. 1 pictures a typical building operation.

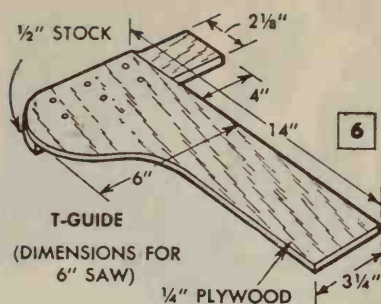


Keep
GUIDE NOTCH
ON LINE, OR
WATCH LINE IN
WINDOW





A T-GUIDE is handy for crosscutting. Guided cut is smoother



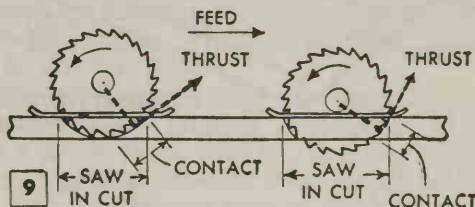
TECHNIQUE

In coming up the opposite side of the roof, however, the operator has no choice—he must support the saw on the narrow part of the base plate.

Crosscutting near the center of a board is best done with a bench setup, as shown in Fig. 7. The T-guide shown in Fig. 6 is a valuable aid for all crosscutting operations. When you make this setup make the projecting part of the T-guide head a little longer than the width of the wide part of the base plate. The first cut will trim the projection in line with the blade. After that, set the head to a pencil line, Fig. 5, to make any cut. A separate T-guide should be made for angle cuts since these cut inside the vertical cut, Fig. 8. You will have to set the saw blade fairly shallow if you use 3/4-in. support blocks in the bench setup,



ANGLE CUTS can be made accurately with a special T-guide. Use separate notch on saw

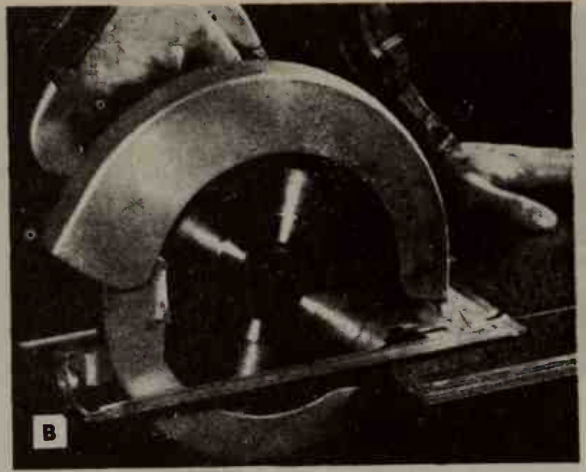
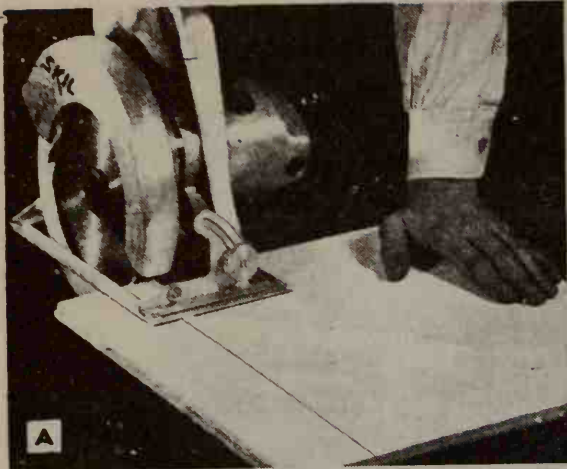


Average Specifications — ELECTRIC HANDSAWS

SAW DIA.	WEIGHT	VERTICAL CUT		MAX. 45° CUT	SPEED R.P.M.	REMARKS
		MAX.	MIN.			
4 1/2"	7 LB.	1 1/4"	0"	1"	6000	SMALLEST PRACTICAL UNIT. CUTS 1" HARDWOOD STOCK.
6"	11 LB.	2"	3/4"*	1 3/8"	5000	BEST SIZE FOR HOME SHOP. EASY TO HANDLE. CUTS 2" STOCK (EXCEPT AT 45°)
7 1/4"	16 LB.	2 3/8"	1/2"*	1 7/8"	5000	POPULAR SIZE FOR LIGHT CONSTRUCTION WORK. CUTS 2" STOCK AT ALL BEVELS
8 1/2"	18 1/2 LB.	2 7/8"	1/2"*	2 1/8"	4200	THE BUILDER'S SAW. MAKES ALL AVERAGE CUTS IN FRAMING STOCK
9 1/2"	20 LB.	3 1/4"	1"	2 1/2"	3800	HEAVY BUILDER'S SAW. BIG BLADE CUTS TIMBERS USED IN BRIDGE AND DOCK WORK

NOTE — AVERAGE SPECIFICATIONS ONLY. SOME UNITS WILL VARY

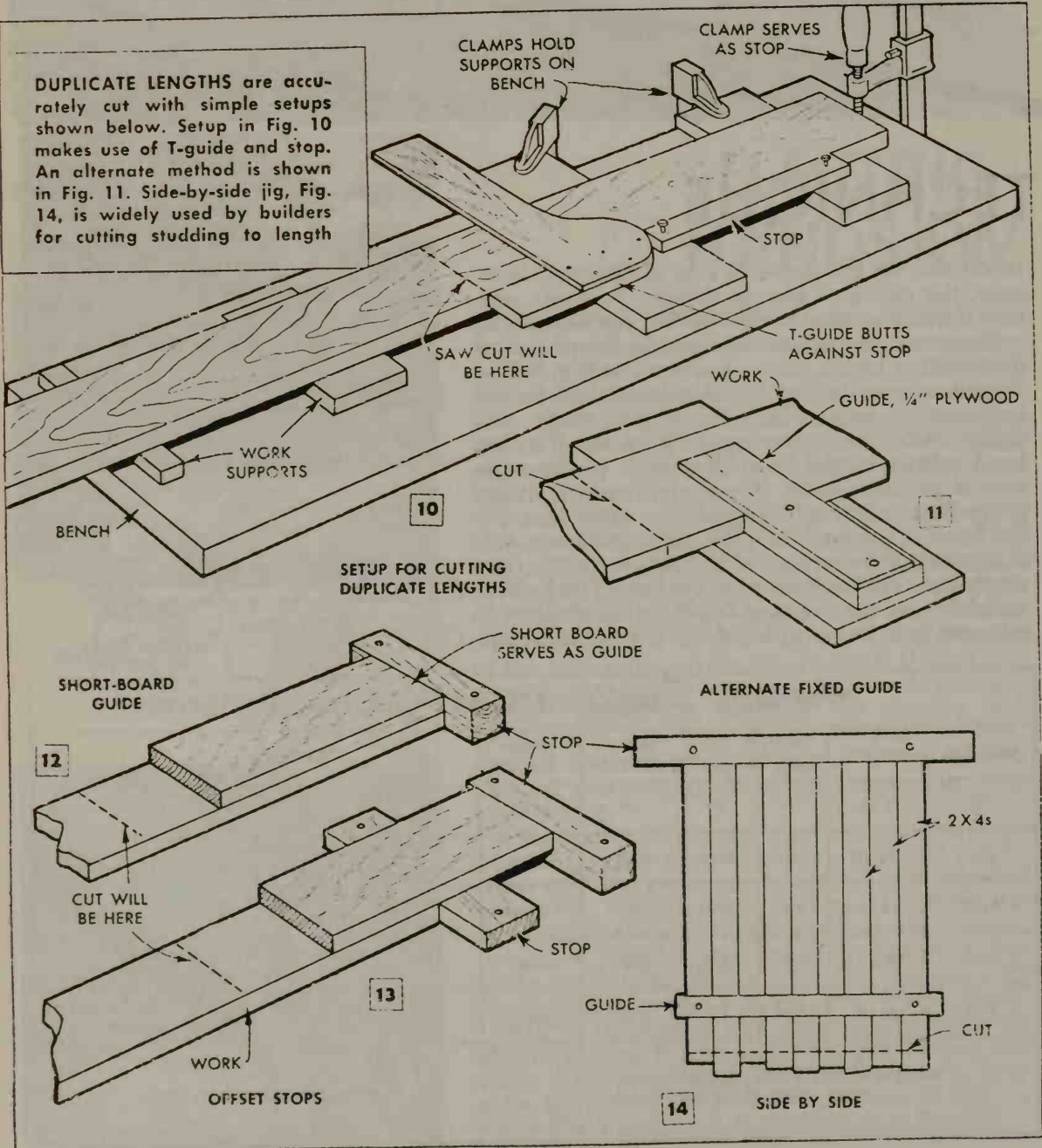
* SOME SAWS ADJUST TO ZERO

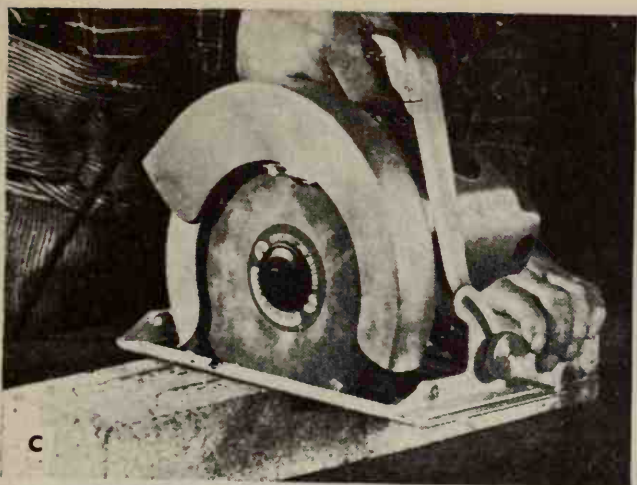


Skillsaw, Inc., photos

BUILDERS USE ELECTRIC HANDSAWS FOR CUTTING NEARLY

DUPLICATE LENGTHS are accurately cut with simple setups shown below. Setup in Fig. 10 makes use of T-guide and stop. An alternate method is shown in Fig. 11. Side-by-side jig, Fig. 14, is widely used by builders for cutting studding to length





ALL TYPES OF BUILDING MATERIALS

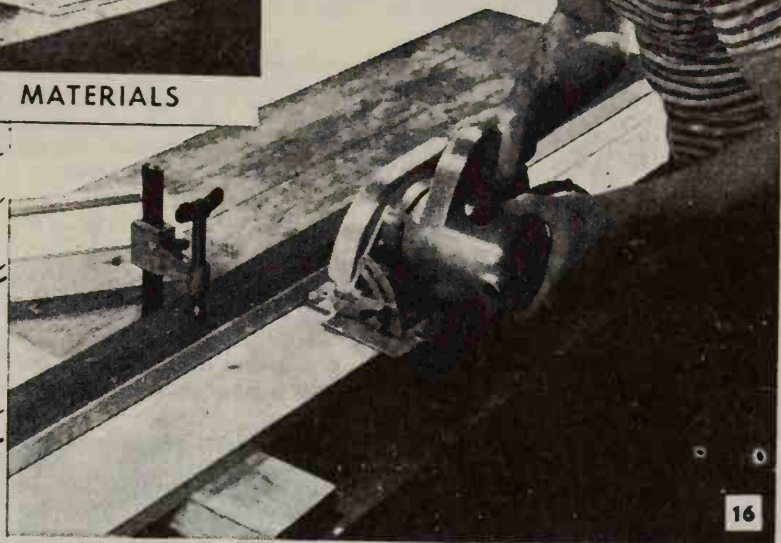
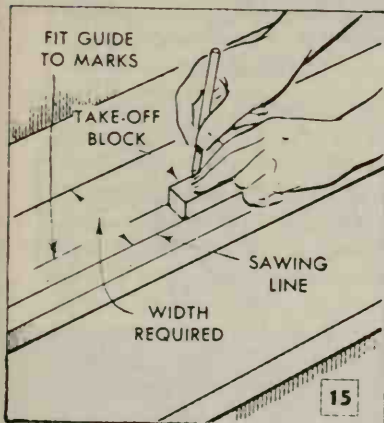


Fig. 7. In most work the support blocks should be cut from 2 x 4-in. stock.

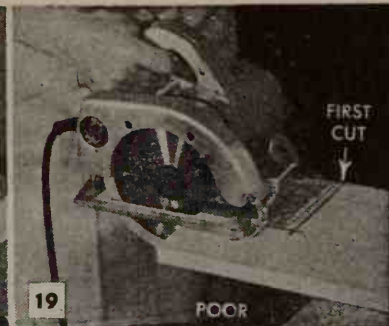
Mechanics of cutting: Fig. 9 shows how the blade cuts. The thrust is forward and upward against the base plate. When the blade is set just to cut through the stock, it has a larger contact area and requires more power. On the other hand, the blade set to maximum depth tends to bind in the cut. For most work, a setting halfway between minimum and maximum projection is best. Because the tool is used freehand, it is highly important to keep the saw teeth sharp and correctly set. File the saw blade after each four hours of use and keep the set at $\frac{1}{4}$ in., or follow the manufacturer's recommendations for filing and setting the blade.

Duplicate lengths: If you are cutting three or four duplicate pieces, probably the best system is to mark each piece. But when you have 10 to 20 pieces to cut, it is worth-while to make a simple jig to assure uniform lengths. Fig. 10 shows a typical setup. Saw halfway through the first board and then mount the various stops as shown. In Fig. 12, the setup makes use of a short board. In Fig. 13, the arrangement is somewhat similar but uses the first board sawed as a guide in connection with offset stops.

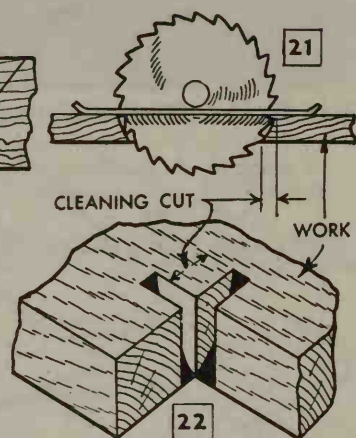
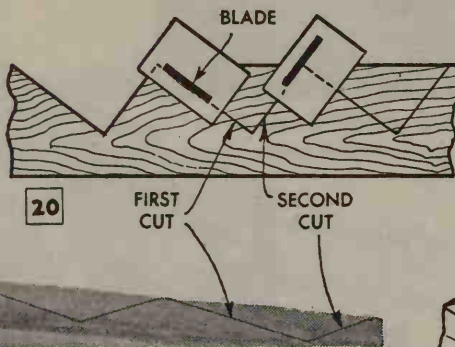
The offset is the width of the wide part of the base plate (4 in. for a typical 6-in. saw). Fig. 14 shows a simple multiple-cutting setup used by builders for cutting studding to uniform lengths. Numerous other setups can be worked out.

Ripping: Ripping cuts can be made accurately with a ripping guide, Fig. 16, or with a guide strip, Fig. 15. Ripping with a guide strip is commonly done from right to left with the narrow part of the base plate bearing against the guide, Fig. 16. To make the setup you first pencil-mark the width of the strip required. Then using a take-off block of a width equal to the width of the narrow part of the base plate, mark the stock to locate the position of the guide strip, Fig. 15. In using the bench setup with support blocks, you can saw right through the blocks or shift as you approach them, as desired.

Notching: On a notching job, always work the two cuts to keep a solid support under the saw, as shown in Fig. 17 to 22 inclusive. Note in Fig. 19 how the wrong procedure requires supporting the saw on the narrow part of the base for the final cut. To clean a circular-sawed notch, it is necessary to saw a little beyond the line, Fig. 22. Always use the blade at its maximum depth



MAKE CUTS SO WIDE PART OF BASE PROVIDES SUPPORT



NOTCHING CUTS must be made in proper sequence so that wide part of base plate is supported on solid stock. Saw is set at maximum depth



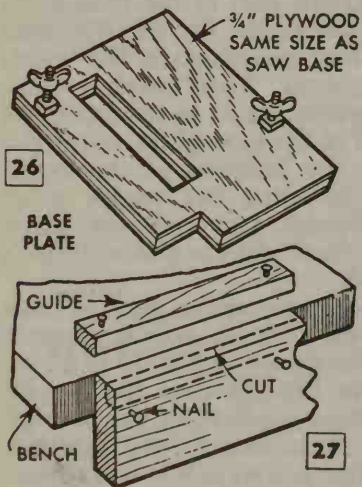
SET SAW TO DEPTH



MAKE CUTS ABOUT $\frac{1}{2}$ " APART



CHISEL OUT WASTE WOOD



SETUP FOR RABBET

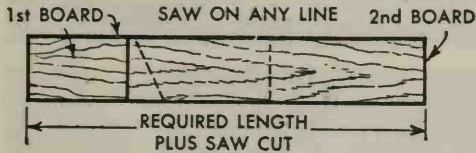
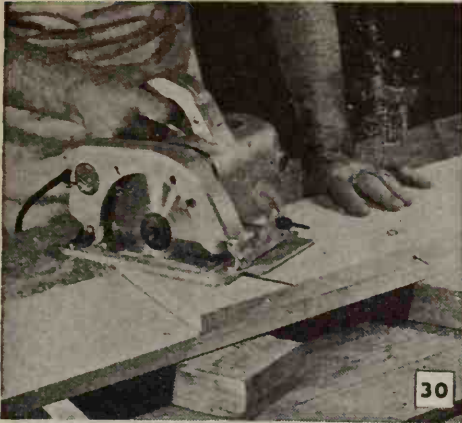
GROOVING AND RABBETING are easy operations with electric hand-saw. Cutting shallow grooves may require use of auxiliary base plate, Figs. 28 and 29, if the saw is of type that does not adjust to zero



SET SAW TO DEPTH



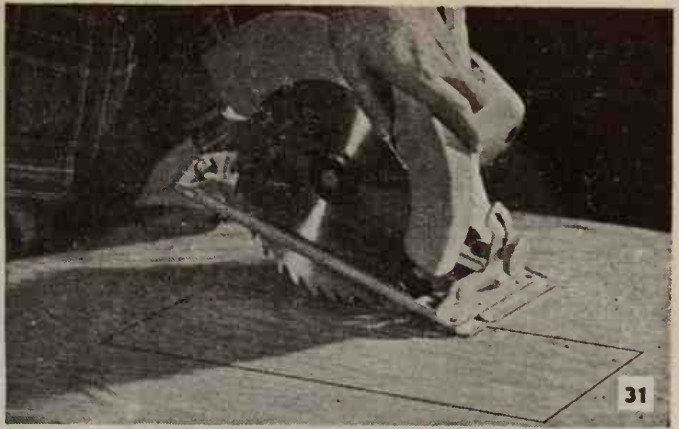
USE T-GUIDE TO SPACE CUTS



for this work in order to keep the cleaning cut at a minimum.* A square-cornered notch is cut by following the procedure shown in Figs. 23, 24 and 25. Unless your saw adjusts to zero, it will be necessary to fit an auxiliary base, Figs. 26 to 29 inclusive, to cut shallow grooves. Instead of the auxiliary base, it is practical to use a $\frac{3}{4}$ -in. riser block nailed or held over the work. With this in place, use the T-guide to walk the saw kerfs across the work, as shown in Fig. 29. When you have a groove or rabbet in the edge of a board, support the work by nailing or clamping it to the edge of the bench top, Fig. 27. Then nail the guide in place and make the cut. The ripping guide also can be used for this operation.

Butt joint: Another job for the electric handsaw is the fitting of plain butt joints. Clamp the two boards or panels together to make the required length plus the saw kerf, and then saw any straight line across the assembly for a perfect joint, Fig. 30.

Pocket cut: This is another very useful electric-handsaw operation. The blade should be set at maximum depth to minimize the length of the cleaning cut. You can pivot the cut in from either the rear or front of the base, but the front pivot, Fig. 31, is perhaps the most practical for average work. The saw is backtracked a little to catch the nearest corner and then can be pushed along the guide line as in straight ripping or crosscutting.



BUTT JOINTS AND POCKET CUTS are regularly made by builders. Butt joint is made by overlapping and clamping two boards as in photo above at the left. Joint will fit perfectly. Pocket cut is made by lowering saw into work



CONVERSION of electric handsaw into table saw is made possible by accessory table. Unit will perform common sawing operations, including shaping and sanding



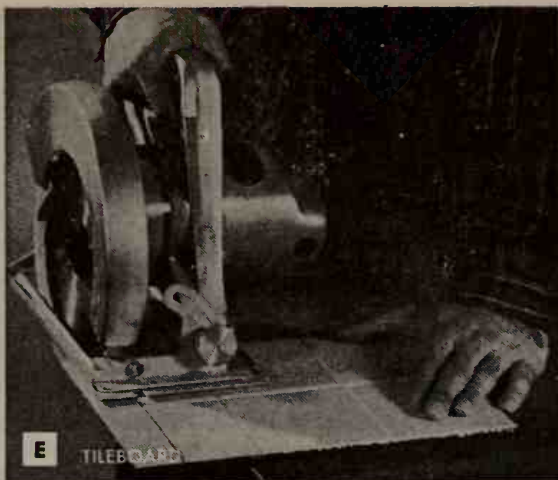
SHAPING



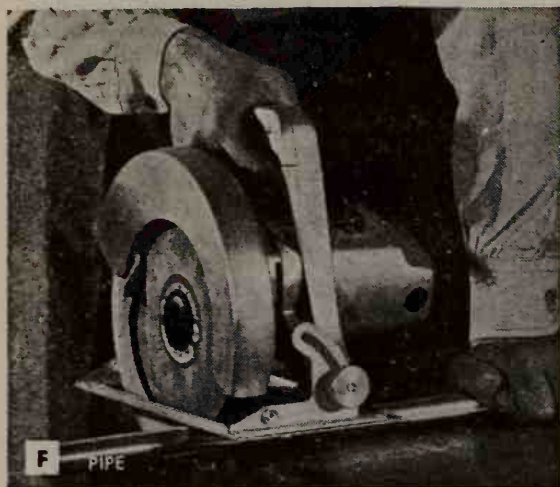
SANDING



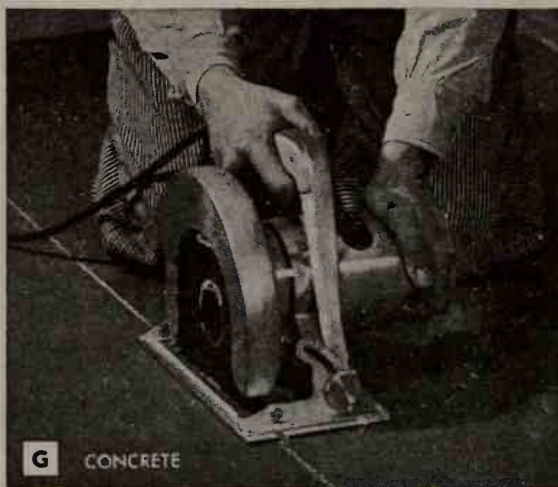
D ROOFING



E TILEBOARD



F PIPE

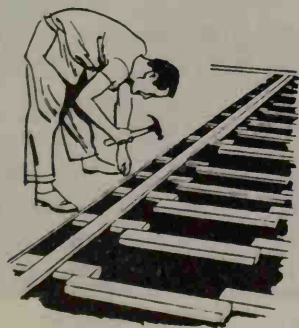


G CONCRETE

Then, after making two of the four cuts, it is sometimes advisable to nail a support across the pocket to keep the waste piece from falling out when the final cuts are made. The telescoping guard must be locked in the open position for this operation. If your saw does not have the guard lock, make one by tapping the frame and inserting a knurled screw to engage a hole drilled in the guard. Fit a light spring under the screw to prevent it from working loose.

Table saw: The electric handsaw can be used as a table saw by fitting it to an acces-

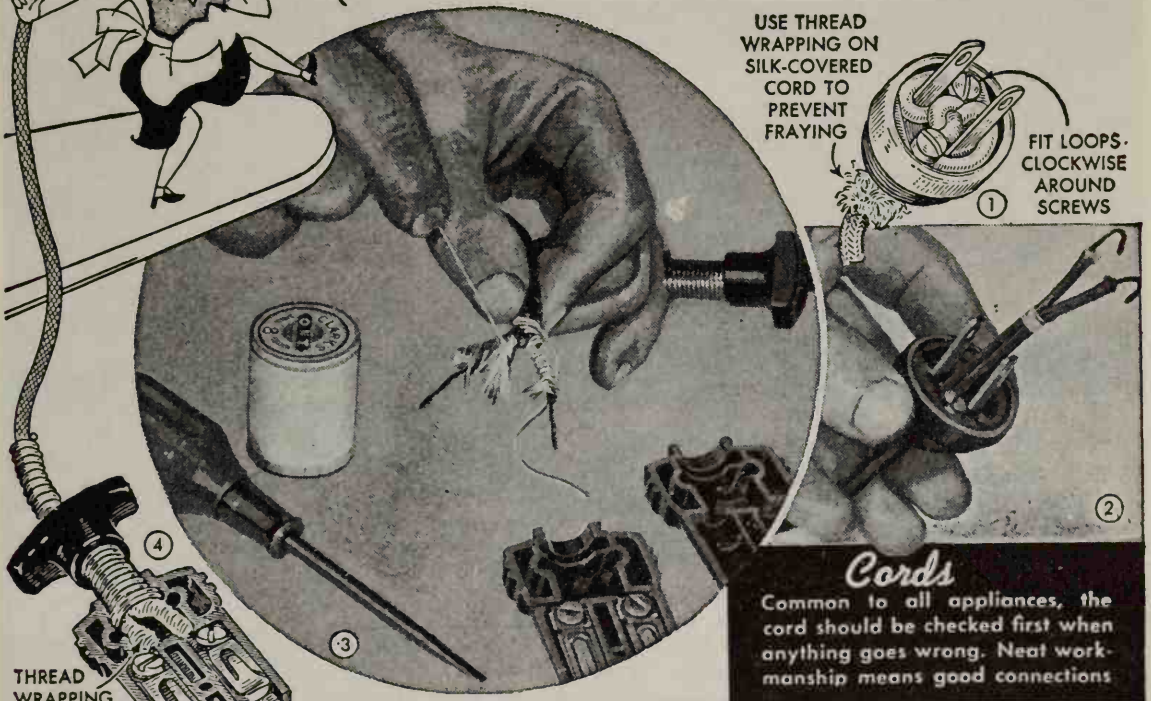
sory table supplied by the manufacturer. Figs. 32 to 35 inclusive show typical operations utilizing accessories which do ripping, crosscutting, shaping and sanding. These units often are the solution to the power-tool problem in the small shop. Photos A, B and C on the previous pages, and also photos D to G above, show how the electric saw, operated manually, is used to cut almost any common building material, including masonry, metal and compositions. Special blades and abrasive wheels are available for cutting these materials speedily and accurately. ★ ★ ★



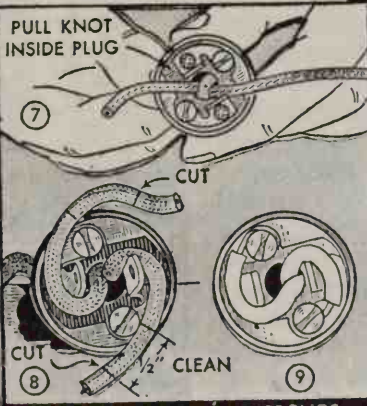
ELECTRIC IRON REPAIR



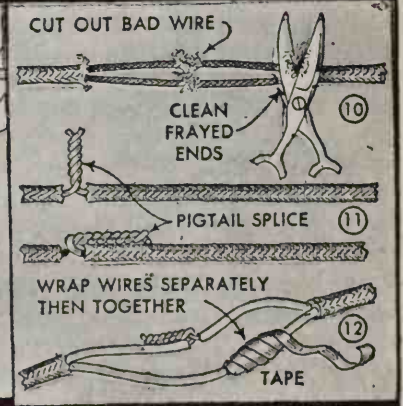
Cords and plugs: Cords and plugs are basic and apply to all electrical equipment. Most persons know how to make necessary repairs, but the few ideas pictured on this page may serve as a "refresher" course. Silk-cov-



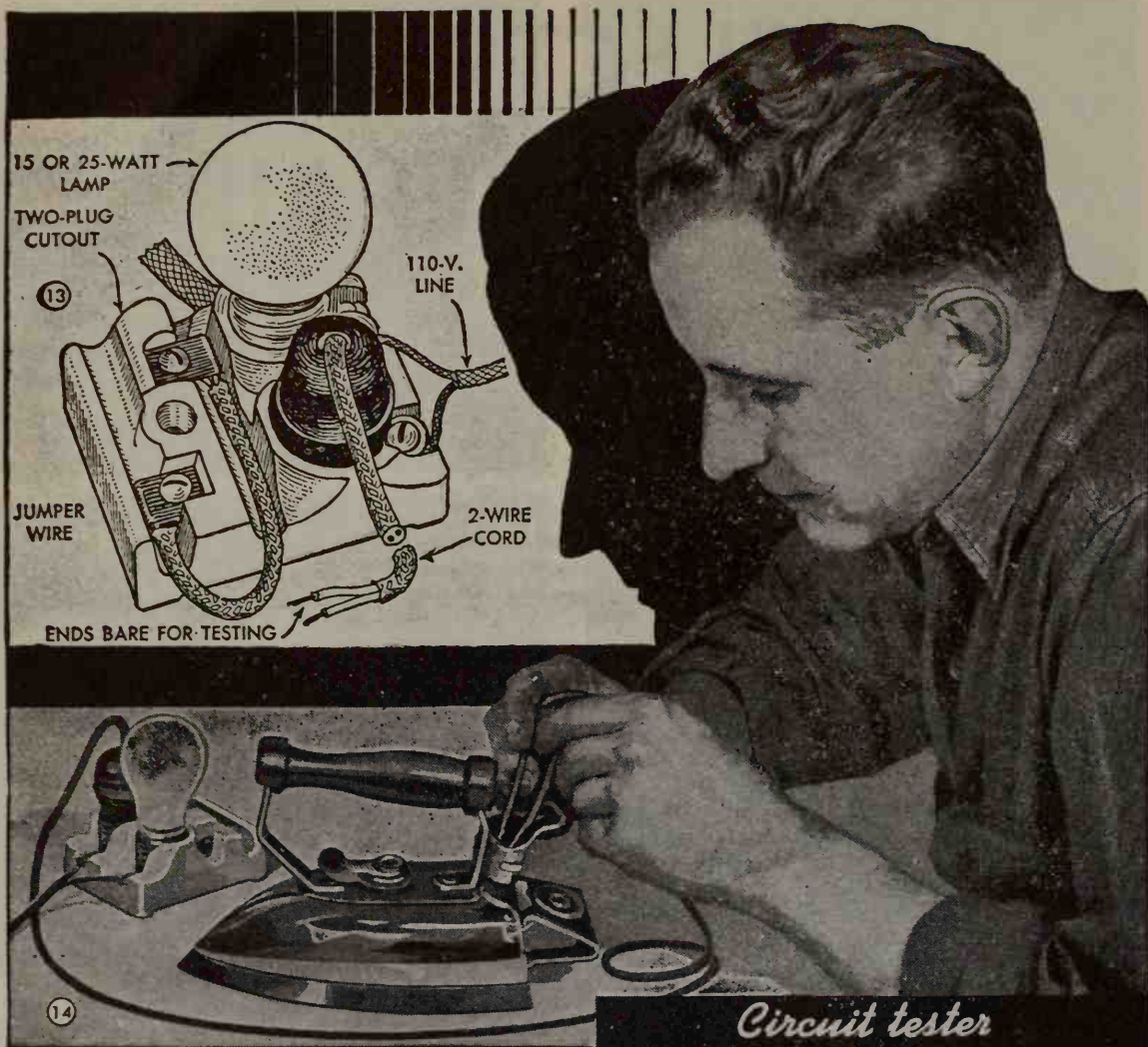
UNDERWRITERS' KNOT PREVENTS PULL ON PLUG CONNECTIONS



WRAP WIRES AROUND PRONGS TO DETERMINE WHERE TO CUT AND CLEAN



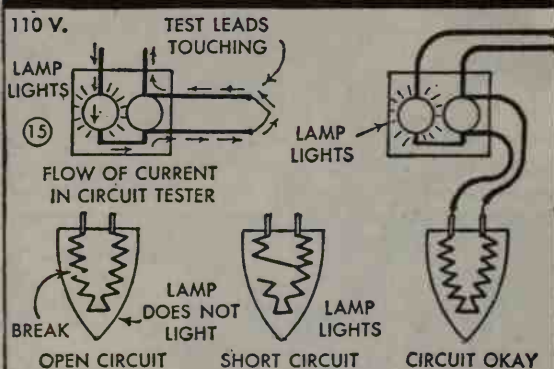
PROMPT ATTENTION TO FRAYED CORD WILL AVOID SHORT-CIRCUIT

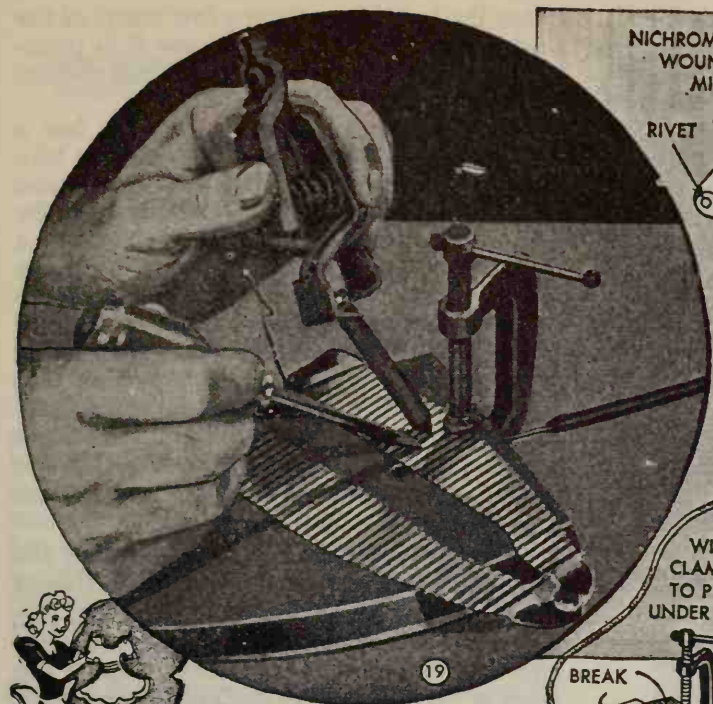


ered cords and asbestos-insulated cords should always be wrapped with thread when making plug connections to prevent fraying, as shown in Figs. 1, 2 and 3. The insulation should be intact right up to the point of contact, Fig. 4. The underwriter's knot for plugs as shown in Figs. 5 and 6 takes the strain of pulling on the cord and prevents strain on the connections. It is especially good with the popular parallel-wire rubber cord. Steps in making plug connections after tying the knot are shown in Figs. 7 and 8. The best practice is to leave the wire long and the insulation intact until actual fitting. Fig. 8 shows where to cut and clean. Fig. 9 shows a plug properly connected—the wire is pulled around the prongs and fitted clockwise under the screw heads. A frayed weak spot in a cord should be spliced promptly instead of waiting until the wire or fuse burns out due to a short circuit. The common splice joint is best made with pigtail splices, as shown in Figs. 10, 11 and 12. Each joint is wrapped separately with friction tape; then the two wires are wrapped together.

Circuit tester

Best method of checking circuits in any appliance is to use the simple circuit tester shown—costs little and is useful on dozens of jobs



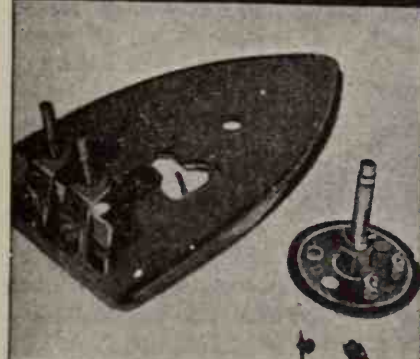


Irons

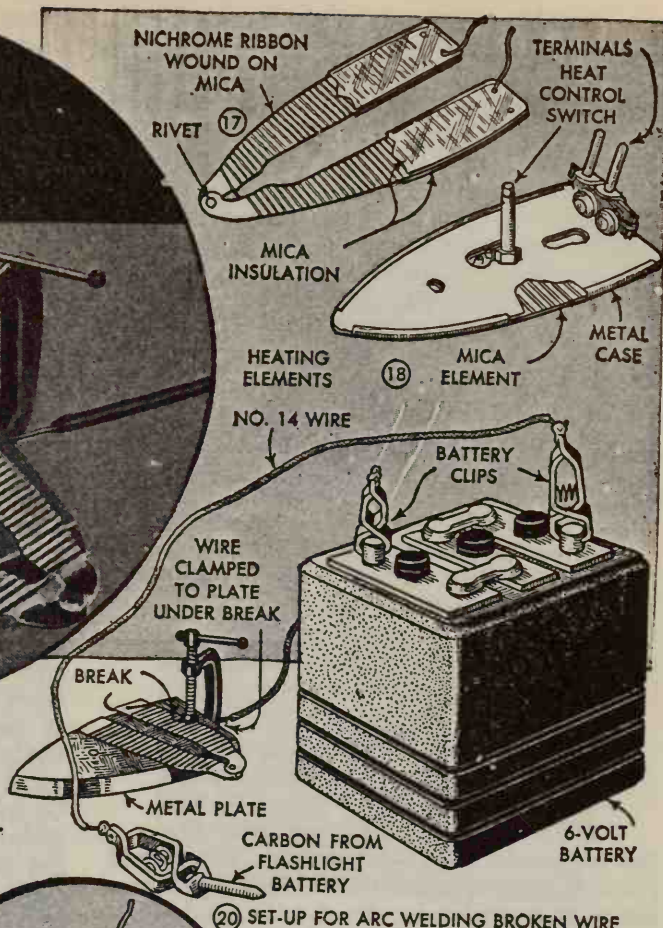
Usual fault is break in heating element, which can be repaired by splicing or arc-welding the severed ends



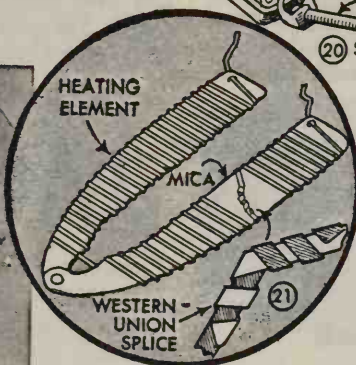
22 LAMP SHOULD LIGHT WHEN TEST LEADS ARE TOUCHED TO SWITCH TERMINALS



23 DEFECTIVE SWITCH CAN BE DISCARDED. ELEMENT WILL WORK WHEN WIRES ARE SPICED



20 SET-UP FOR ARC WELDING BROKEN WIRE



Circuit tester: While breaks in an electrical circuit usually can be traced visually, it is quicker and better to use a circuit tester. This is made up as shown in Fig. 13 and costs less than fifty cents. How it works is shown in Fig. 15—if you touch the two test leads together you make a complete

circuit, causing the lamp to light. Likewise if you apply the test leads to any circuit, such as a flatiron, as shown in Figs. 14 and 15, the lamp will light if the circuit in the iron is not broken. Also, it should be noted that the lamp will light if a short circuit exists, Fig. 15, but positively cannot light when the circuit is broken. The current passed by the bare wires of the circuit tester is limited to the size of the bulb used, and is not sufficient to actually heat the iron, run a motor, or do anything else which the straight 110-volt line would do. This doesn't mean that you shouldn't be careful—play safe and treat the two test leads as "hot."

Checking electric iron: Using the circuit tester, apply the leads to the prong terminals, as shown in Fig. 14. If the heating element is all right, the lamp will light. Apply one lead to the prong terminal and the other to the sole plate, Fig. 16. The lamp should not light. If it does the circuit is grounded, that is, some part of the wiring is bare of insulation and

touching the sole plate or cover. No light across the terminals shows that the circuit is broken. In this case, remove the handle, cover, and any other parts necessary to expose the heating element. The most common type of heating element is ribbon Nichrome wire wrapped on mica and insulated on either side with mica, as shown in Fig. 17. Better grade elements are covered with a metal case, Fig. 18, and it is necessary to pry off the case. Still other elements are built right into the sole plate in a solid mold; this type is not repairable except by obtaining a new replacement part.

Patching Nichrome wire: A break in the Nichrome ribbon or wire can be patched by twisting the two ends together, as shown in Fig. 21. A better method is to fuse the broken ends together with a small makeshift arc-welding outfit, as in Figs. 19 and 20. In use, the pointed carbon should be touched to the break delicately and only for an instant. You will get a flash of white hot wire and the two ends will fuse together. Prolonged contact generates too much heat and burns the wire completely. No flux is needed although borax can be used if desired. Some-

times the break is within a few turns of the post terminals, and in this case it is practical simply to unwind the broken section and make a new connection.

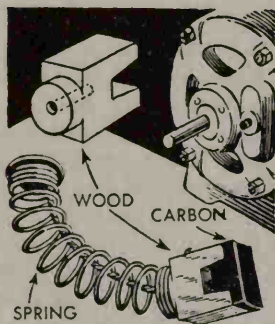
Electric-iron switch: If the iron has a heat-control switch, test it across the terminals, as shown in Fig. 22, to determine if the fault is in the heating element or the switch. If the switch is defective and a replacement not available, the iron can be made usable by twisting or welding the two ends together, as indicated in Fig. 23. There is little that can be done with a defective switch; make certain, however, that the thermostatic disk is not jammed open (saucer shape). Try mild pressure with your fingers in manipulating the disk—it should have a curved bell shape when the iron is cold.

Other heater-type appliances: Apply the same general tests as described. Always check the cord first (use test lamp and run current through both wires separately), and then proceed systematically until the fault is discovered. Some appliances, such as inexpensive toasters, can be checked visually since the heating element is in full view. Breaks in round Nichrome wire can be spliced much the same as described for ribbon wire. In all cases, press the splice flat and make it as tight as possible—any slight amount of arcing from a loose joint will immediately burn the wire.

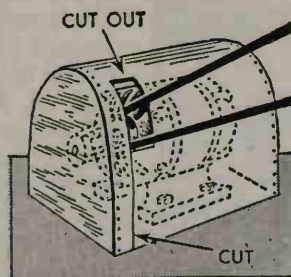
ELECTRIC MOTOR

Emergency Repair for Brush In Electric Motor

If you break a brush in a small electric motor, and a replacement is not at hand, here is one way that an emergency repair can be made. Just shape a piece of wood to slip into the brush holder, slot one end and round the other to take the brush spring. Then shape the commutator end of the broken brush to slip into the slot in the wood. This will lengthen the brush so that it can be used. Be sure that the carbon portion of the repaired brush makes good contact with the holder so that the electric circuit is not broken.



Cover Protects Small Motor

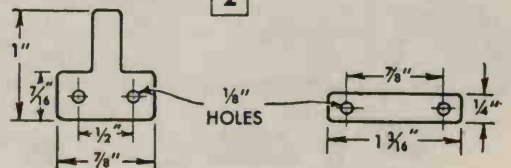
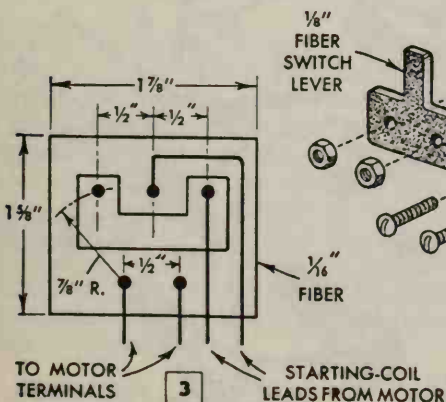
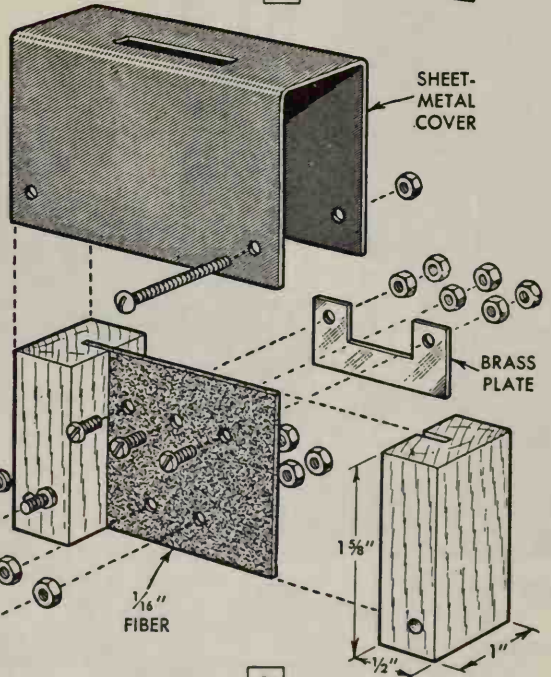
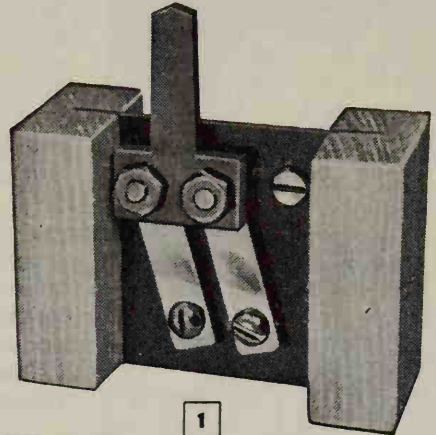
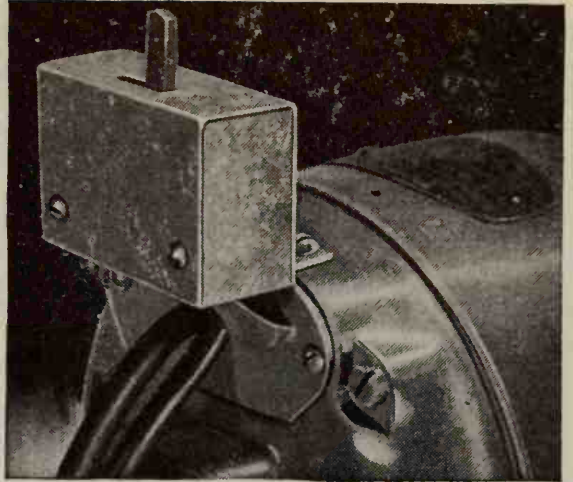


Tacking a piece of linoleum over the edges of two semicircular boards provides a hood which protects a small motor from falling objects. The linoleum cover is cut out for the belt and a slit is made from this opening to the bottom edge of the cover. The slot allows the hood to be lifted off the motor.

ELECTRIC MOTOR DIRECTIONAL SWITCH

This inexpensive motor directional "switch" differs from the commercial reversing type in that it is used in conjunction with the motor switch. This feature eliminates the possibility of accidentally starting the machine in the wrong rotation. While a directional switch generally is used in operating a shaper or a metal lathe, such a switch also can be adapted for use where a countershaft or a motor is used to drive two machines placed on opposite sides of the drive pulley. This obviates need for crossing the belt.

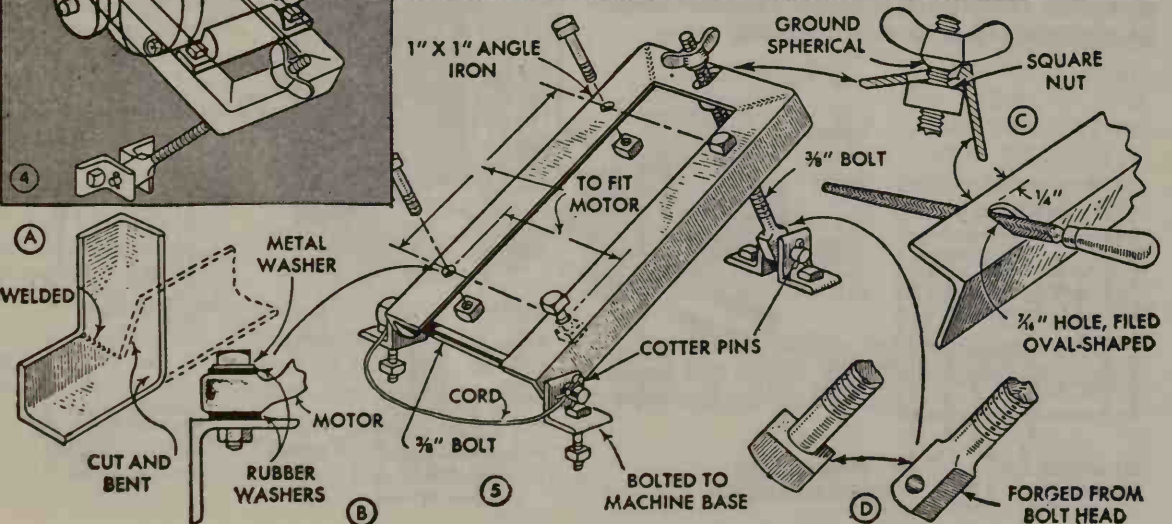
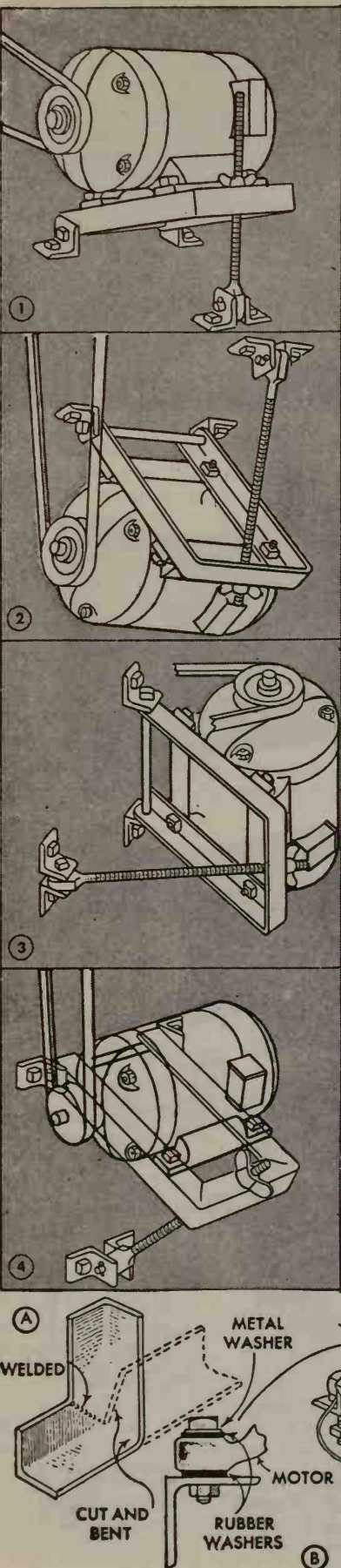
If the motor is of the split-phase or capacitor type, reversing rotation ordinarily is done by transposing the position of the two starting-coil leads. But when the motor is equipped with this directional switch, the direction of rotation is reversed by just moving a lever. Fig. 1 shows what the switch looks like with the cover removed and Fig. 2 shows the parts and how they go together. To install it on a motor, remove the motor cover plate and disconnect the two starting-coil leads, leaving the motor-switch leads connected. Next, short lengths of wire, connected to the motor terminals, are brought through holes in the cover plate for connection to terminals on the directional switch. The directional switch is connected to the starting-coil leads according to the wiring diagram in Fig. 3 and then mounted on the motor with an angle bracket. Remember that in using this switch, the motor should come to a complete stop before changing the direction of rotation. Positive contact must be maintained to prevent arcing.



ELECTRIC MOTOR MOUNT

CHANGING a motor from one machine to another in the home can be done in less than a minute with this all-position motor mount. Some of the many different positions in which it can be used are shown in Figs. 1 to 4 inclusive. Only motors built for vertical as well as horizontal mounting should be used as illustrated in Fig. 3.

Dimensions for the angle-iron frame (Fig. 5) are not given as these will vary according to the type and size of motor used. The corners are cut, bent and welded as detailed in Fig. 5, A, and two holes are drilled to take a $\frac{3}{8}$ -in. bolt on which the frame hinges. A third hole is drilled and filed to an oval shape for an adjustment screw, which is a $\frac{3}{8}$ -in. square-head bolt forged and drilled as shown in Fig. 5, D. Belt tensioning is accomplished by adjusting a square nut under the angle-iron frame and tightening a wing nut as in Fig. 5, C. Four angle-iron brackets are bolted permanently to each machine on which the motor mount is to be used. Mounting the motor between rubber washers as indicated in Fig. 5, B, will reduce vibration and eliminate motor hum.



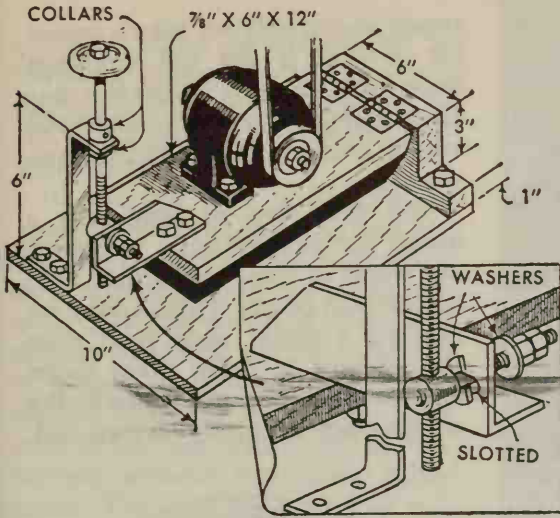
Hinged Motor Mount Has Handwheel for Belt-Tension Adjustment

Designed for use where a power tool is driven from below, this hinged motor mount provides for uniform belt tension

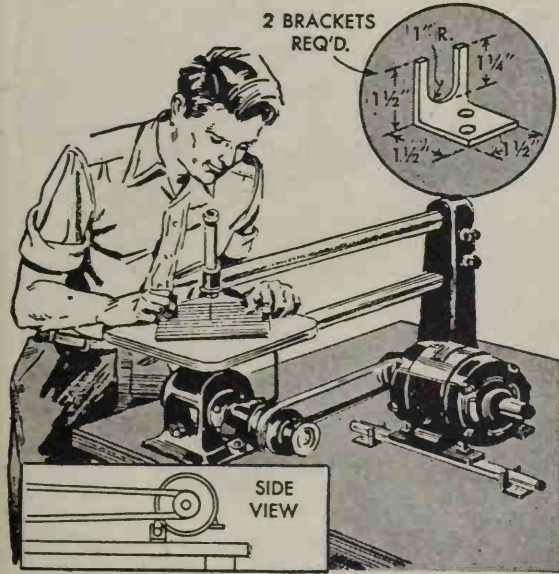
without imposing the weight of the motor directly on the bearings. Slack in the belt is taken up by turning a handwheel. This raises or lowers a hinged shelf to which the motor is fastened.

The drawing at the left shows how the device is made. The adjusting mechanism consists of a threaded shaft supported vertically by a flat-iron bracket and two collars. The shaft passes through a tapped hole in the head of a specially turned bolt and the end of the shaft rests on the bottom board.

The turned bolt is supported by a piece of angle iron which is bolted to the end of the motor shelf as shown in the detailed portion of the drawing. Two nuts on the bolt permit it to be tightened sufficiently to provide a sliding fit in the slot in the angle-iron support. Note that the rear edge of the motor shelf is cut at an angle to allow it to be lowered slightly beyond a right-angle to the hinge mount.

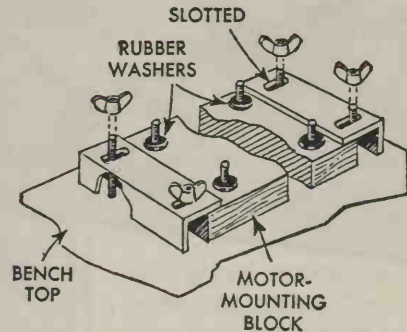


One Motor Operates Many Tools With This Quick-Change Mount



Using one motor to operate several tools is not a difficult task if you use a mounting like the one shown. It permits the motor to be moved from one tool to another by simply removing the belt, lifting the motor and carrying it to the desired tool. The mount consists of a length of 3/4-in. pipe to which the motor is bolted, the pipe fitting into metal brackets provided at each tool. Weight of the motor keeps it in place, and it swings into the belt, which also helps to keep it in position.

Quick-Change Mounting Block For Home-Workshop Motor



If you do not have enough electric motors to use one on each power tool, a mounting block, such as the one shown, will enable you to use a single motor for several tools and change it quickly from one to the other as desired. As in the detail, the block is a piece of hardwood to which the motor is bolted. In the correct position behind each tool, short lengths of angle iron are mounted with bolts and wing nuts, the bolt holes in the iron being slotted to permit adjustment of the angle-iron pieces. In use, the hardwood block to which the motor is fastened is merely slipped in between the two angle irons so that the upper edges of the latter frame the block. In this way, tightening the wing nuts clamps the block and holds it in place, while loosening them allows the block to be slipped out and moved to another tool. If necessary, one side of each angle iron can be ground down so that its height closely approximates the thickness of the wooden block.

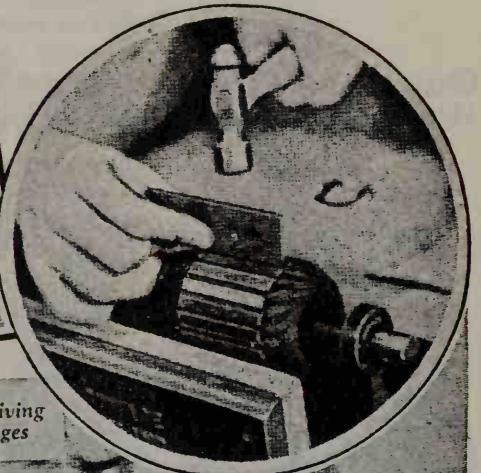
ELECTRIC MOTOR



Above, sawing out wire slots in commutator bars. Below, commutator bar marked with center punch



Loosening and driving out the coil wedges



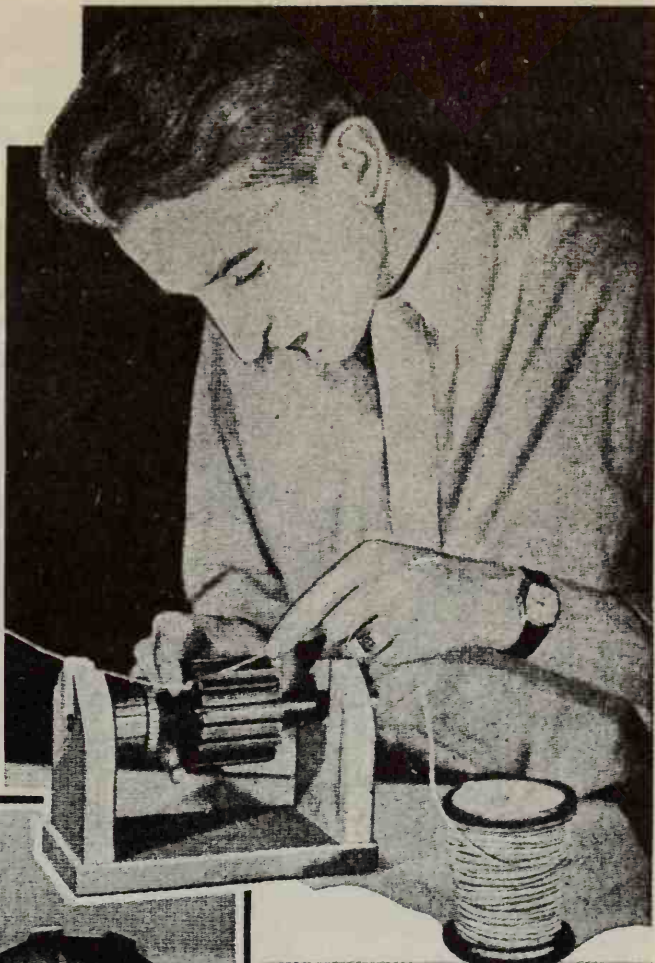
ELECTRIC motors, either a.c. or d.c., whose windings have been burned out or damaged may be repaired or completely rewound by anyone with only such simple tools as are available in any shop. Before taking the motor apart the frame parts should be marked with a file to simplify reassembly. End plates of some motors will fit together in several positions but the armature may not turn freely unless the parts are replaced in their original positions. If the armature has already been stripped of its old winding, it is not possible for the amateur to work out the windings required, unless the necessary information as to the wire size, turns and connections can be procured from the manufacturer of the motor. Most motor



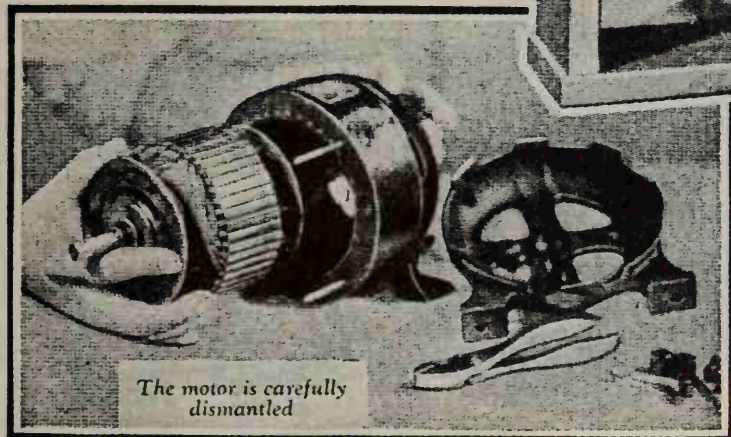
REWINDING

If care is taken the wedges can be saved for replacement. If they are damaged new ones will need to be cut to the same size from wood or sheet fiber.

As the old wire is removed, a simple system of marking and recording should be used so that the new windings may be made exactly like the old ones. The first step in recording the old windings is to find the last coil which was wound onto the armature. This will be the one which can be unwound without disturbing other coils. The two ends of this coil are soldered to two of the copper commutator bars. One of the ends



Stand for holding the armature makes rewinding easier



The motor is carefully dismantled

is located and the bar to which it is connected is marked with a center punch to indicate that it is segment No. 1. This same coil end is then cut from the segment and lifted from the first slot through which it passes. The metal on each side of this slot is then marked with an X to indicate that the slot between the marks is No. 1 slot. To make identification of the other slots and segments easy, the armature is held in front of you with the commutator closest. The marked bar is No. 1 and the next bar to it when your eye follows around in the same direction as the hands of a clock is bar No. 2, etc. The slots in the armature

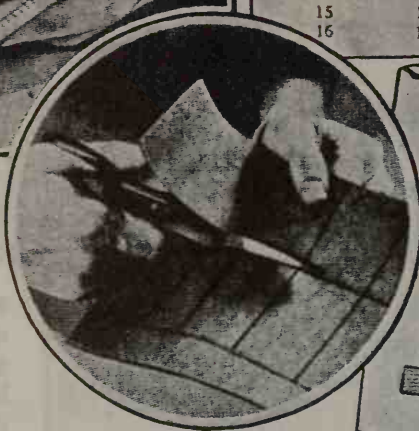
are given numbers in the same direction. The winding may be recorded as removed by drawing a diagram like the one shown as the work progresses. Although this gives adequate information after only one coil has been removed in the hands of an experienced winder, the table method of recording will be found simpler to follow by the beginner. An example of such a table is shown. To illustrate the use of the table method of recording we will go through the process of taking data on an armature which has 16 slots and 16 segments in the armature. After locating the last coil placed on the armature, we mark one of the commutator bars to which it is connected and cut the end of the coil from this bar and lift it from the slot. This slot is marked No. 1 as explained above. This information is re-



Armature slot is marked with a file



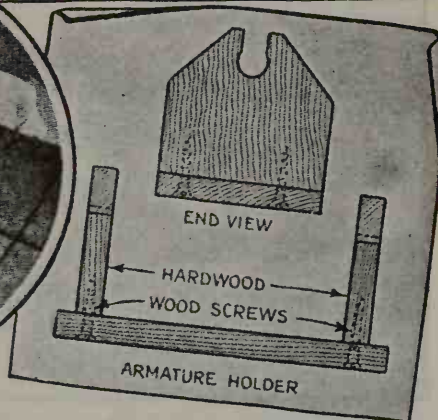
Above, measuring old slot insulation to get pattern for new insulation which is cut from wood or sheet fiber



corded in the first line of the table. We next unwind this same wire from the next slot through which it passes. We find this to be No. 9 slot and record it as shown. We can now proceed to unwind the coil completely while counting the turns. In this case there were ten turns in the coil as indicated in the table. Pulling the wire free, we find that the other end of the coil is connected to bar No. 2. We can now remove the wire completely; however, it should be placed in a box so that all of the wire removed from the armature may be weighed in order to determine how much wire will be required for rewinding. The next coil removed and recorded by the same method should be the one which is left free for removal without disturbing the remaining coils. In

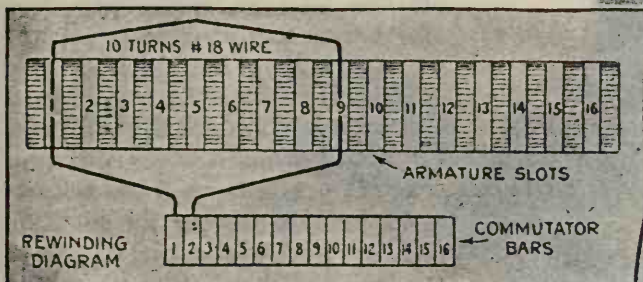
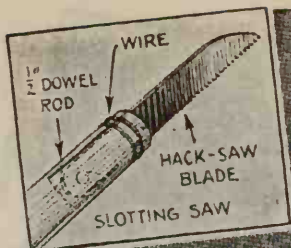
our illustration this coil has one of its ends connected to bar No. 2. After noting this in the table we cut it loose and remove the coil exactly as before, recording all of the data in the table. The remaining coils are removed and recorded in exactly the same manner. When all of the coils have been removed we weigh the wire and add about 10 per cent to find the weight of the wire needed to do the job. The size of the wire is next determined with a wire gauge.

Recording an Armature Winding				
Size of Wire Used—No. 18. Weight of Wire—2¾ Lbs.				
From Bar	To Slot	To Slot	To Bar	Turns
1	1	9	2	10
2	2	10	3	10
3	3	11	4	10
4	4	12	5	10
5	5	13	6	10
6	6	14	7	10
7	7	15	8	10
8	8	16	9	10
9	9	1	10	10
10	10	2	11	10
11	11	3	12	10
12	12	4	13	10
13	13	5	14	10
14	14	6	15	10
15	15	7	16	10
16	16	8	1	10



Armatures are wound and connected by so many methods that it is impossible to make a general rule for winding and connecting the coils; therefore the exact connections as found on the armature, regardless of the number of slots and segments, should be followed carefully when removing the old winding and placing the new one on the core. In some armatures you will find that there are dead coils that are not connected to commutator bars. When this condition is found it should be duplicated in the rewinding. Also, you may find that some of the commutator bars are not connected to coils but simply connected to

other bars. When this condition is found it should be noted so that the same connections can be made when rewinding. If the commutator is removed it must be replaced so that bar No. 1 is over the same point on the shaft as it was originally. Some rotors, as the rotating member of an induction motor is called, are wound with only two coils of wire. The ends of these coils are connected to brass or bronze disks upon which brushes rub when the motor is in operation. When taking data for rewinding this type of motor, the slots should be numbered starting at any convenient point and the wire removed carefully, noting not only the slot from which it was removed and the number of turns but also the direction in which the coil was wound so that new wires can be wound on in exactly the same manner.



When working on a motor of this type it would be well to work out a simple table to meet your special requirements before removing any of the wire. The size of the wire for the two coils will be different so it will be necessary to use two sizes of wire for rewinding.

With the old wire removed, the insulation from the slots should be removed and one piece of it measured, so that new insulation can be cut to slightly larger dimensions from fiber with a photo trimmer. The old wires and solder are next sawed out of the wire slots in the commutator bars. A convenient tool for this job is made by mounting a length of hack-saw blade in a piece of dowel rod. The space between the commutator and the iron core is then partly filled with plain cotton tape, which will serve to prevent the ends of the coils from being pressed against the metal shaft. Shellac may be used to hold the cotton tape in place. A winding frame of suitable dimensions to hold the armature

is then built from wood. With the armature mounted in the rack, the winding is started by winding on the last coil that was removed, or the coil recorded at the bottom of the record table. The ends of the coil should be left long and marked for the bar to which they are to be connected so that all of them may be soldered to the proper bars after the entire rewinding job has been completed. Any convenient plan of marking the leads may be used. While winding, the coils should be neatly formed and the wires pressed tightly into the slots, always being careful to avoid damaging the insulation. The ends of the coils should be neatly formed so that there will be



Upper, gauging the wire thickness. Lower, coil leads carefully soldered to commutator bars

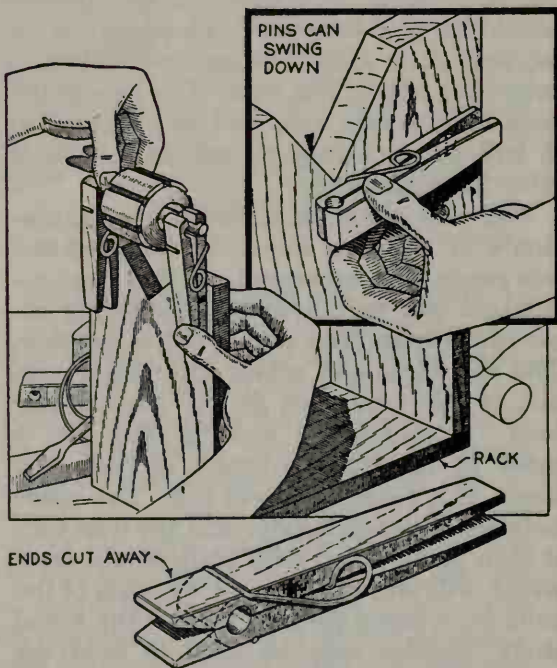
plenty of room for the entire winding. The wire used should have the same kind of insulation as was originally used on the machine to insure plenty of room. When the winding has been completed, the leads are pressed into the bar slots and soldered securely, after which the surplus solder may be removed with a file. The windings are then bound down tightly as they were before and given a coat of varnish. If a can of varnish large enough for the job is available the best plan is to dip the armature and allow it to soak up as much varnish as it will. After a thorough drying, the armature is ready for installation in the motor.

Induction motors frequently have a rotor without windings but have two windings on the frame or stator. These machines are very easy to rewind by simply removing the old winding and recording the slots, turns, wire sizes, direction of windings and connections. A suitable ta-

ble for recording these values may be made by anyone. If an induction motor hums when connected to the line but will not start until given a brisk spin you will know that the starting winding, or the winding of small wire only, has burned out. In this case only this winding has to be replaced.

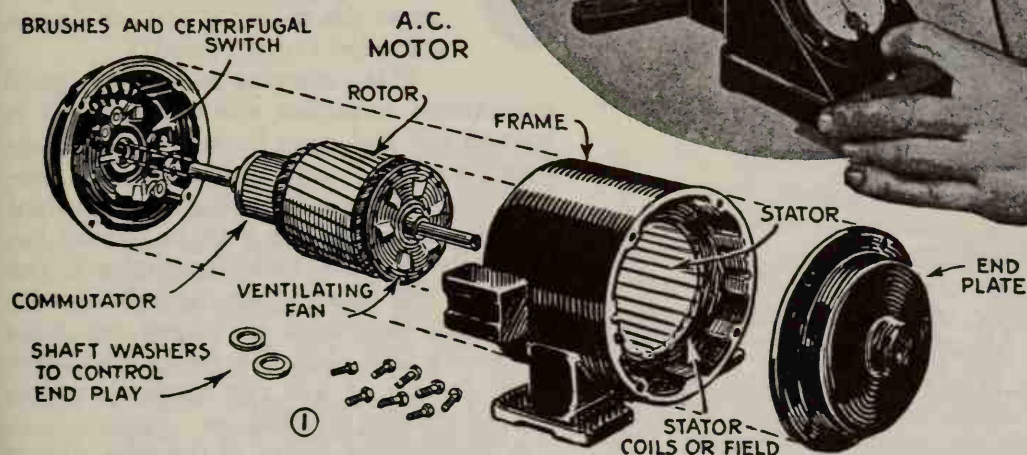
How to Hold Small Armatures in a Large Rack

Finding that his regular rack to hold generator and starting-motor armatures was too large for small armatures from horns and heater fans, one mechanic fitted the rack with two spring-type clothespins to do the job. The ends were cut off the pins as indicated, after which they were mounted upright on each side of the V-cut at one end of the rack. A large wood screw holds each pin so that it can be swung down out of the way when the rack is used for a large armature. In testing for grounds one test lead is clamped in one of the pins and is held tightly against the armature shaft.



Spring-type clothespins screwed to one end of armature rack for holding small armatures

ELECTRIC MOTOR SERVICING

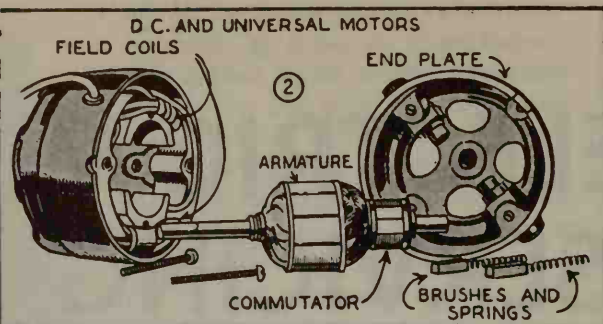
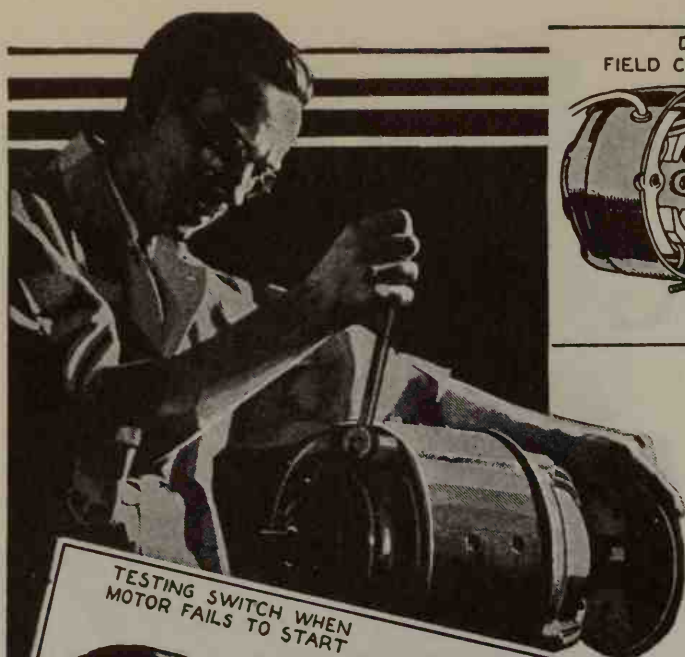


A MOTOR which fails to start when the switch is closed is either not receiving power from the lines or has a burned-out coil or a faulty connection inside the machine. First determine whether the fault is in the motor or the switch. Fig. 3 shows how to make this test. The switch is turned on and the test-lamp wires touched to the leads connected to the motor as shown. If the lamp fails to light, the switch is faulty. If the lamp lights, the switch is in good order and the trouble is either a broken wire from switch to motor or in the motor itself.

Faults which result in a motor failing to start include burned-out coils, poor connections, worn-out or broken brushes and damaged centrifugal starting switches. The last named are found on split-phase and repulsion-induction motors only. To locate the exact source of trouble speedily, first remove the brushes and examine them. If they are worn out, broken, or have weak springs, they should be re-

placed. If there is mechanical interference which prevents them from rubbing against the brass rings or commutator, the end plate will have to be removed and this corrected by taping down the lead wire which has become loose.

A typical a.c. motor of the commutator type is shown in Fig. 1. When a.c. motors hum without starting, either the starting coil or the automatic switch is at fault. This may be verified by removing the load from the motor and giving the pulley a spin by hand. If the trouble is in the starting coil or automatic switch, the motor will take hold and run. The brushes should next be removed if they have not already been inspected. Should they be faulty, replacement will usually result in satisfactory operation. But if the brushes are in good order and the rings upon which they rub are clean and free from corrosion, the centrifugal switch or the starting winding is the source of the trouble. In this case, the centrifugal switch, which is built

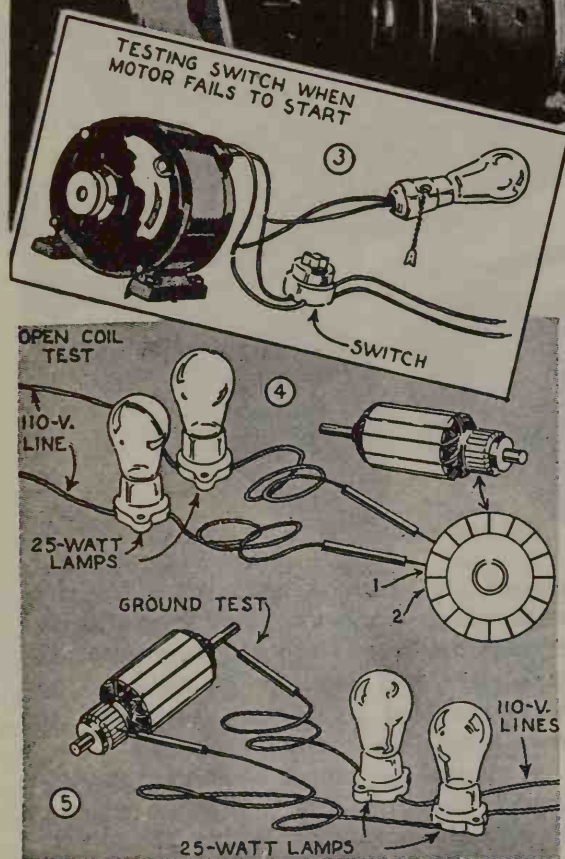


throws them apart, turning off the current from the starting winding, when sufficient speed is reached. The common troubles encountered with automatic switches of this type are due to weak springs that allow the contacts to open when the motor is idle, or due to corroded contact points.

If the starting switch is in good mechanical condition, the starting coil is burned out and must be replaced to produce normal starting. Split-phase a.c. motors whose starting windings are burned out may, however, be kept in service indefinitely without making repairs if the operator will merely give the belt a husky tug when the motor is turned on. This procedure will start the motor and after once starting, it will run normally without the starting winding.

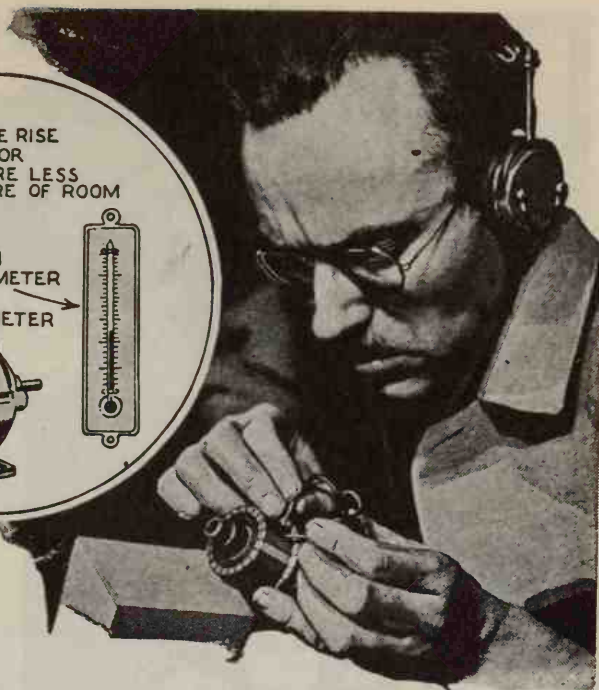
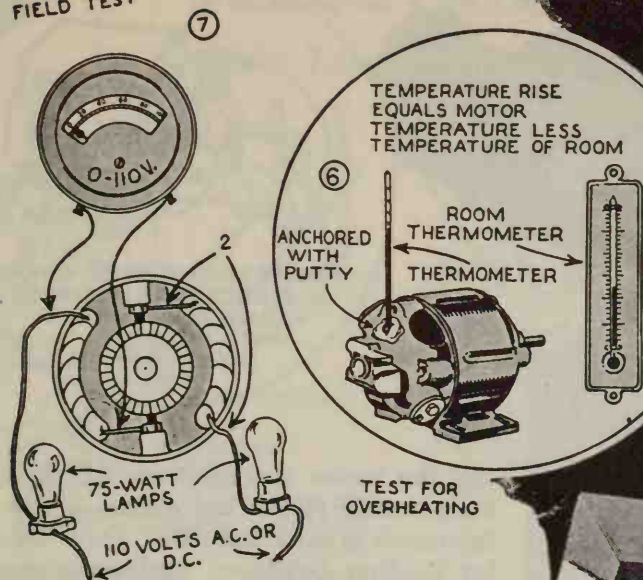
A commutator motor of the type shown in Fig. 2 which fails to start on occasions, usually has a burned-out coil in its armature. This may be verified readily by turning on the current and rotating the shaft of the motor through a few degrees by hand. If the fault is due to a burned-out armature coil, this will result in the motor taking hold and running but with sparking on the commutator. Then the motor should be dismantled and either rewound or a temporary repair effected.

Fig. 4 shows a method of locating open-circuited or burned-out armature coils. The prods from the lamps are touched to adjacent commutator segments as shown. If the lamps light, the coil between these two segments is in good condition. The points should then be moved to positions 1 and 2 and the test repeated, after which the same procedure is continued until each adjacent pair of segments has been tested. Pairs of segments that do not light



in as a part of the rotating element of the motor, must be inspected after removing the end plate. There are hundreds of different designs for automatic switches, and it is not possible to point out exactly the procedure to take. However, if the motor is dismantled and the parts inspected, this kind of trouble will be simple to locate. The centrifugal switch is simply a mechanical arrangement, which holds two contact points together when the motor is idle and

FIELD TEST



the lamps are connected to a burned-out coil. If the user of the motor is familiar with the methods of rewinding, he may remove this coil and replace it with an exact duplicate. If it is not practical to rewind the coil immediately, then the two segments which did not light the lamp may be connected together with a short length of copper wire, constituting a temporary repair. This connection should be made by soldering on the back side of the commutator so that the wire used for joining the segments will not rub against the brushes or cause mechanical troubles. "Jumping" the segments together in this manner will reduce commutator sparking and allow the motor to start, regardless of the position to which it may come to rest. A motor so repaired will not perform at its maximum efficiency and additional burnouts are likely, particularly if overloaded.

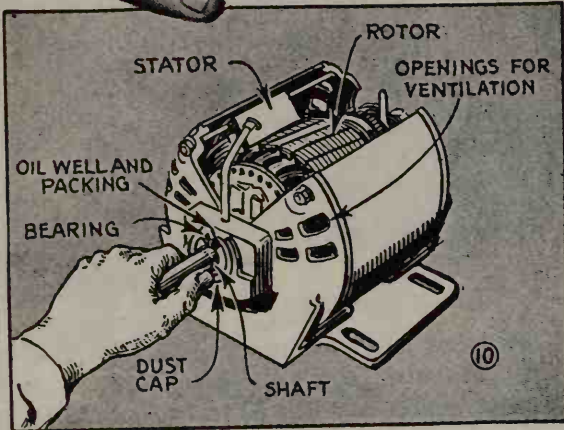
The other cause of a motor failing to start is a burned-out field or stator, as the stationary unit is called in a.c. motors. Tests for fields will be explained later. A motor which does not run at its normal speed is usually overloaded. This condition can be determined by removing the belt and allowing the motor to idle. If it operates at normal speed without load, then a light load should be applied and its effect noted. Other causes for low speed

are, poor lubrication; excessive friction in the bearings, due to a bent shaft or to a shaft which has been damaged by grit in the oil wells; short-circuited coils; open-circuited coils and grounds. All of these faults, except damaged coils, may be located by inspection. A grounded armature may be detected by making the tests shown in Fig. 5. To locate shorted coils use a radio headset and touch the tips of the two leads to adjacent commutator segments, progressively, until all have been tested in this way. While performing this test, each brush, with the field disconnected, is run to one of the 110-volt supply lines, a 25-watt lamp being cut in each line to furnish the low current required for producing sound in the headset. If the coil connecting a pair of segments being tested is in good order, a buzz will be heard in the receiver, if alternating current is used. If direct current is used, a click will be noticed at the time the feelers are touched to the segments. The absence of a click or buzz indicates that these two segments are short-circuited.

In the case of grounds and shorts, the commutator and coils should be examined for damaged insulation. Some of the wires in the windings will have their insulation damaged and the bare wire either touches the shaft or other metal parts of the armature causing a ground, or touches other



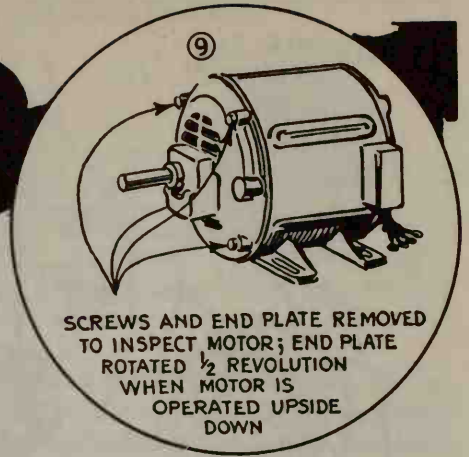
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wires causing a short. The simplest method of repairing damaged insulation is to place a section of varnished cloth or tape between the wire and its point of contact with metal or other wires. If the wire is large and has sufficient mechanical strength, the tape may be bound in place with thread and coated with shellac. If the wires are small, paper is placed under the wire as in Fig. 8, and the whole coated with shellac.

When a motor overheats, the oil well should be inspected to make certain that the machine is well lubricated. If, after removing the load from the motor, the armature will spin freely by hand without excessive friction, then the trouble is due to overloading of the motor, damp windings, or short-circuited coils. Overload is easily tested for by allowing it to operate idle, its temperature being noted with a thermometer as shown in Fig. 6. The bulb of the thermometer should be attached to the frame of the motor or to any other suitable part of the motor with a ball of putty. The motor is allowed to run without load until the thermometer ceases to show an increase in temperature. The difference between the room thermometer



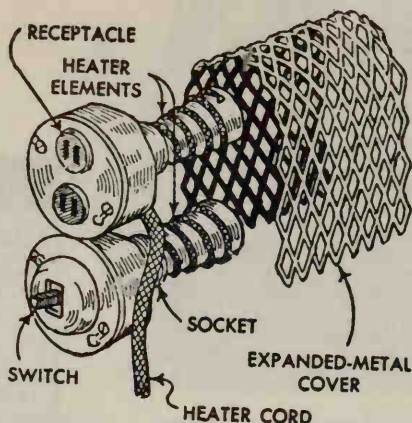
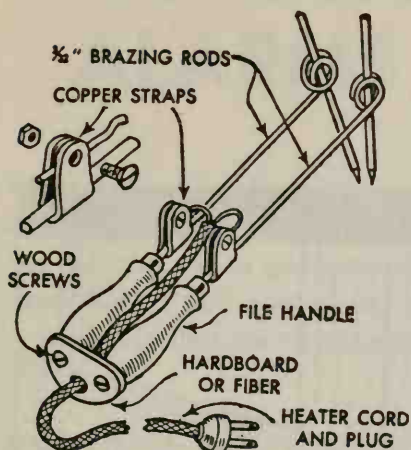
SCREWS AND END PLATE REMOVED TO INSPECT MOTOR; END PLATE ROTATED $\frac{1}{2}$ REVOLUTION WHEN MOTOR IS OPERATED UPSIDE DOWN

and the motor thermometer will give the temperature rise of the motor. If this difference is greater than 100° Fahr. the motor is often defective. Ordinarily, motors are designed so that their temperature will be about 75° above room temperature. Many small motors operate at considerably higher temperature than this, therefore, the motor need not be condemned as faulty if its temperature rises up to 100° above the room temperature. If the motor shows up well under test without any load while running, it should again be tested in the same way while pulling its regular load. Overheating of the motor being tested, under this condition, means that it is somewhat overloaded.

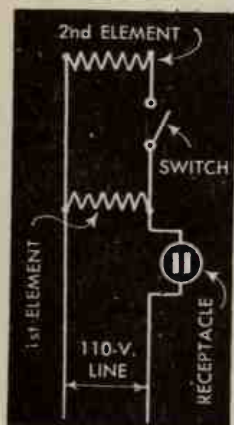
If the field coils are found to heat excessively, the motor should be dismantled and the fields connected to test lamps as shown in Fig. 7. Voltmeter readings are then taken, one tip being left connected to one lead wire to the motor, while the other is first placed in the position shown, and then moved to the other two positions indicated by 2. It should read the same in both instances. If this is not the case, the coil with the low reading is shorted and should be replaced. In cases of motors having more than two field coils, all of them should be left connected in series and voltages taken across each. After a motor has been dismantled, its reassembly must be carried out carefully. Fig. 9 shows the end-plate screws, which must be drawn up carefully to avoid getting the plate out of alignment. Turning the motor shaft by hand as shown in Fig. 10, while drawing up these screws, will help to produce uniform tension.

ELECTRIC TORCH

Electric Torch Made From 600-Watt Heater Elements



(low-heat) position, only a little current passes through the torch, whereas in the "on" (high-heat) position, both heater elements operate to send full amperage through the torch. *Caution:* Plugged in, the torch becomes electrically "hot" and should be treated as such to avoid a shock from



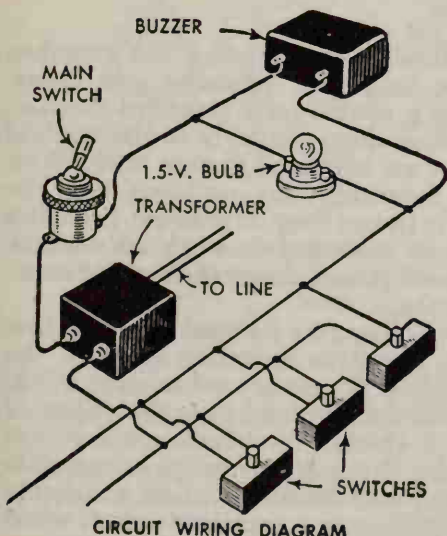
Two outlet boxes, a duplex receptacle, two porcelain sockets, a toggle switch and two 600-watt heater elements provide the parts for the resistance unit of this homemade electric torch, which is designed to handle both light brazing and hard soldering. The sockets are screwed to the bottoms of the outlet boxes and wired according to the diagram with asbestos

touching the exposed parts. In use the tips of the two carbons are brought together by squeezing the handles. The carbons are held together momentarily and then slowly spread apart. This produces an arclike flame which is directed at the work and controlled by varying the pressure on the handles. The arc will form better with the switch at high heat, after which the current is cut to low heat. Use only cored carbons made especially for electric torches and readjust carbons as they burn away.

When brazing, silver soldering or hard soldering, be sure that the parts to be treated are clean and covered with a good flux before beginning. Use an asbestos board for a base when doing extensive work.

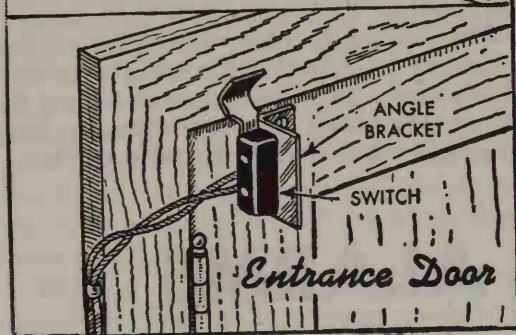
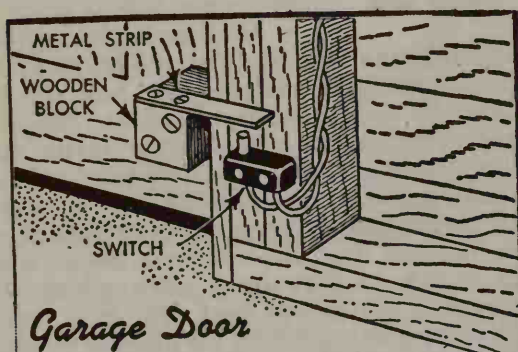
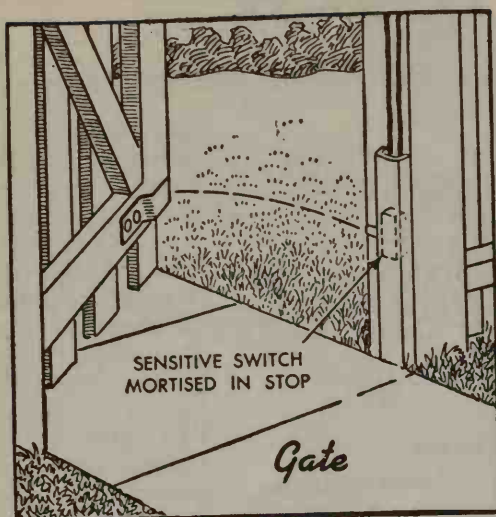
heater cord. With the switch in the "off"

ELECTRICAL ALARMS



YOU'LL get the jump on prowlers before they break in if electrical "night watchmen" are installed on doors and windows to tip you off. When a window or door is opened, pressure on tiny switches is relieved, causing a circuit to close and sound a buzzer in the bedroom. By wiring small lamps into separate circuits for the front and rear of the house, they will glow when the circuit is closed to indicate at a glance the part of the house being invaded. The system also can be wired to automatically turn on exterior floodlights and scare away intruders.

Each circuit consists of a master switch, a 6-volt buzzer, a 1.5-volt lamp and as many sensitive switches as required. These are wired as shown in the diagram to operate either off the doorbell transformer or four dry cells, and are



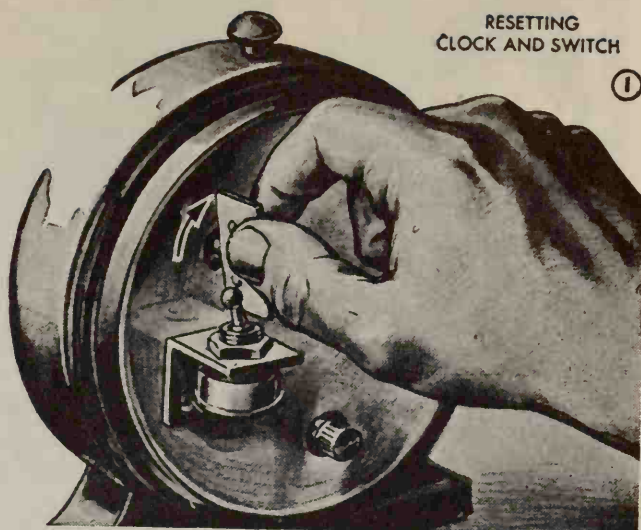
placed in a little box which is mounted on a wall where it can be seen readily. The sensitive switches are wired in parallel in an open circuit, using bell wire for the installation. The easiest way to install the wiring is to merely run it along the woodwork, fastening the wire with small insulated staples. However, if your home is a one-story dwelling, the wiring can be concealed in the walls by drilling up from the basement. Closing of any one sensitive switch completes the circuit and sounds the buzzer. Normally, the master switch in each circuit is left open during the day and closed when retiring. Sensitive switches are available at most electrical stores and sometimes as war surplus. They should be of the type that remain open when depressed. The accompanying drawings sug-

gest methods for mounting the switches on gates, basement windows and doors. Mounting a switch on a standard double-hung sash is done similarly to the method shown for an overhead garage door. With a little ingenuity the switches may be adapted to fit any door or window. Switches also can be arranged to work on window screens and screen doors during the summer months.

Heat switches may be used in connection with the sensitive switches to warn the family of fire. These are set to close at 180 deg. F. and are mounted near the ceiling of a room. A chicken-brooder control switch is ideal for this purpose or an automobile thermostat may be mounted on a suitable bracket to operate a sensitive switch when the thermostat expands.

ELECTRICAL ALARMS

Winding keys on clocks flip toggle switches, which turn the alarm system on and off at predetermined times. Lights and motors can also be controlled the same way

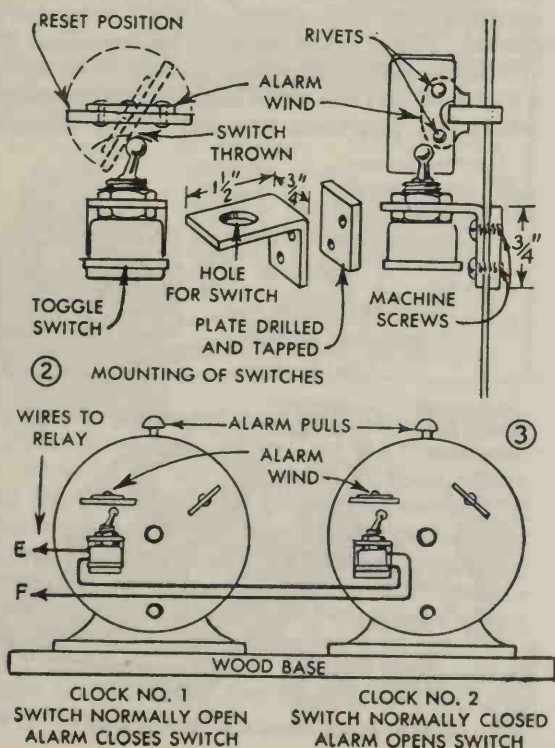


WITH this alarm system, it is possible for a store owner to set the alarm and depart through a door as usual without the alarm sounding. After a predetermined time following his departure, a clock will turn on the alarm system, thus initiating the period of protection. Early on the following morning, just before the arrival of the person who opens the store, a second clock will disconnect the alarm.

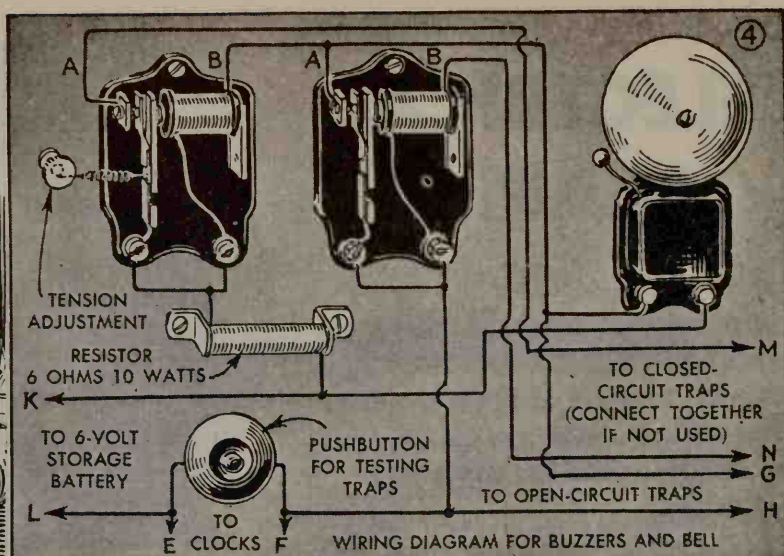
Mounting the clock switches: Two cheap alarm clocks, two toggle switches and three buzzers will be required. Both clocks are modified in exactly the same manner. An ordinary toggle switch is mounted on the clock by means of a bracket as shown in Fig. 2. Before doing this, the clock move-

ment must be taken from the case carefully, after which the bracket is spotted in the position that will permit the alarm-wind key to throw it when the alarm sounds. With these positions marked, the back of the clock is drilled after which the bracket and a metal reinforcing strip are attached. Then the clock is reassembled and the alarm key is fitted with an extension to push the toggle switch from one position to the other. The key should turn about one-quarter of a revolution, and in so doing, throw the switch to the opposite position. The edge of the key should remain against the ball of the toggle at this point so that the alarm will not run down. When properly adjusted, the switch is reset by turning the key to its original position, Fig. 1, and then throwing the toggle switch back.

Fig. 3 shows two alarm clocks on a base with their switches properly connected for use with a simple alarm system. It should be noted that clock No. 1 is set in such a position that the clock closes the circuit, while switch No. 2 is set so that the clock opens the circuit. The wires E and F are to be connected to the corresponding connections on a pushbutton as shown in Fig. 4 on the opposite page.



Buzzers converted into alarm releases: Three buzzer units, one with a bell, will be required to complete the remaining parts of the alarm system. Both buzzers should be reconnected as shown in Fig. 5, after which they are mounted on a board or panel approximately 1 by 6 by 10 in. The first one shown in Fig. 4 must be modified further as in Fig. 6. A long screw is driven into the hole in the board at the relative position indicated so that it can be rotated to apply additional tension to the armature of the first buzzer. The buzzers and the bell are next connected as shown in Fig. 4.



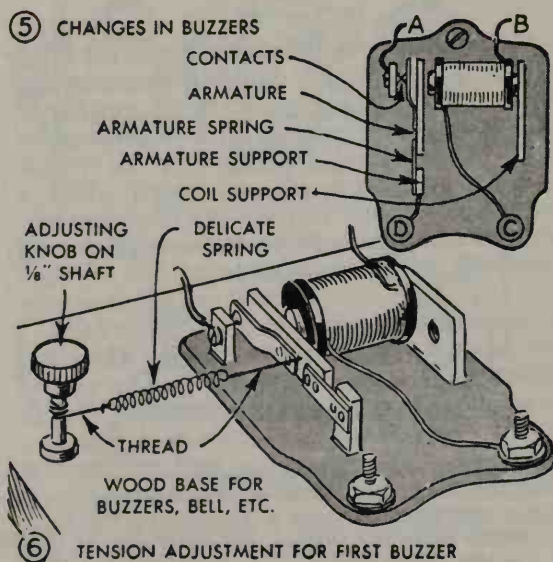
The resistor used in the wiring may have to be altered to suit the particular buzzers, as the resistance should be such that when the current is applied to the coils, the armatures can close and the coils will not heat too much. The lead wires marked K and L are connected to a storage battery. The leads E and F are connected to the wires from the clock switch as previously explained.

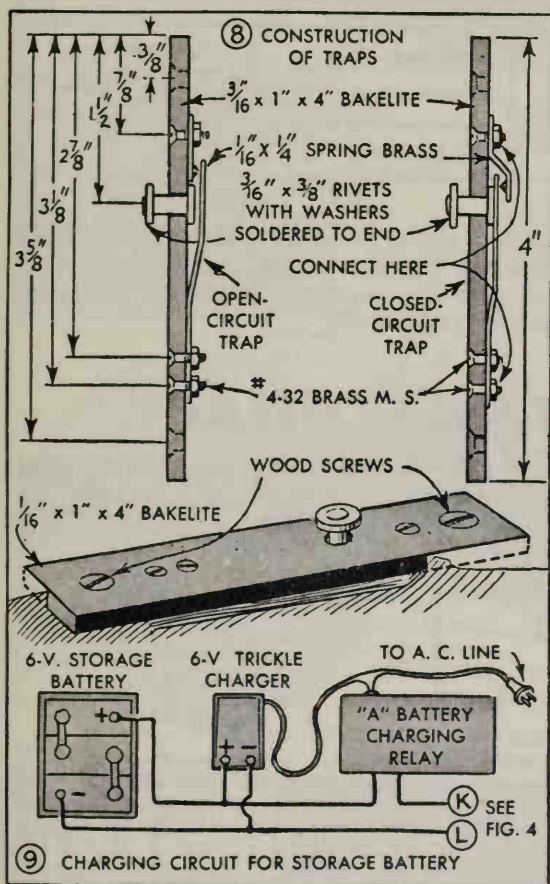
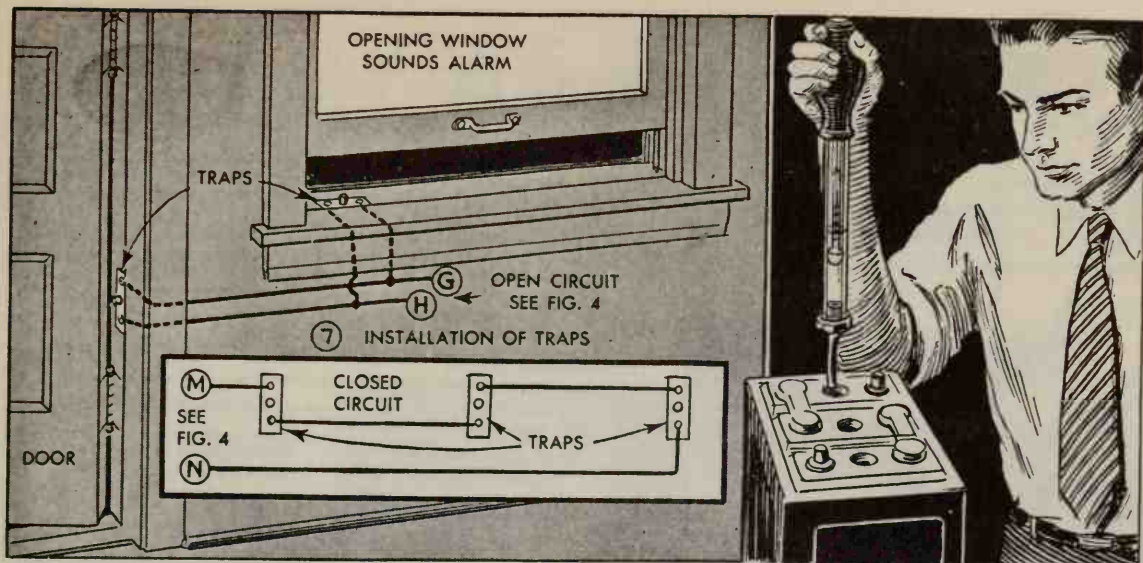
Testing connections and adjusting tension screw: For testing the connections and adjusting the tension screw, a jumper wire should be connected temporarily between lead wires M and N. The lead wires G and H should be left open for test. After making these connections, the battery is connected temporarily to the leads K and L. When the tension adjustment on the first buzzer is correct, the armature of buzzer No. 2—the right-hand one in Fig. 4—should be pulled against the coils immediately, and the armature on the first buzzer should be unaffected. If the first buzzer should close, thus causing the bell to ring, the battery should be disconnected immediately and the tension increased by turning the adjustment screw. Increases in the tension should be made in small steps. Between increases the battery should be reconnected until the armature of the second buzzer always closes and the armature of the first buzzer remains open. After the correct adjustment has been attained, the battery should be connected and disconnected repeatedly to make sure that in each instance only the second buzzer is affected. When this condition prevails, the outfit is ready to be put into service.

In order to test the system further, the jumper wire between M and N leads may be removed while the battery is connected to the system. Removal of the wire will cause the bell to ring. Then the jumper

should be replaced and the bell should continue to ring in spite of the fact that the jumper has been put back into its original position. With the system in this condition, the lead wires G and H should be touched together. This should cause the bell to ring again, and it should continue to ring when the leads are disconnected. From these experiments, you can see that we have a dual-purpose burglar-alarm system, which can be used either with open-circuit traps or with closed-circuit traps as will be explained later.

Construction and installation of traps: Open and closed-circuit traps are shown as A and B in Fig. 8. When the rivet heads are depressed, the open-circuit traps are opened, and the closed-circuit traps are closed. These traps should be installed in windows, doors or other locations in such a manner that the rivet heads are depressed when the premises are left. They should

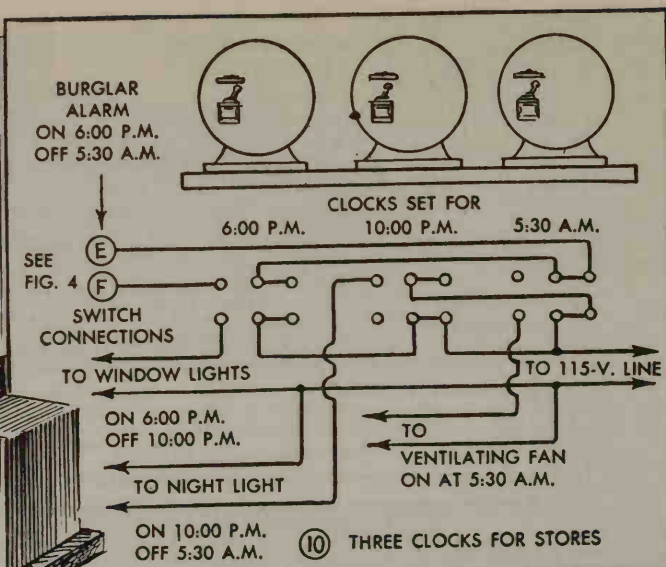
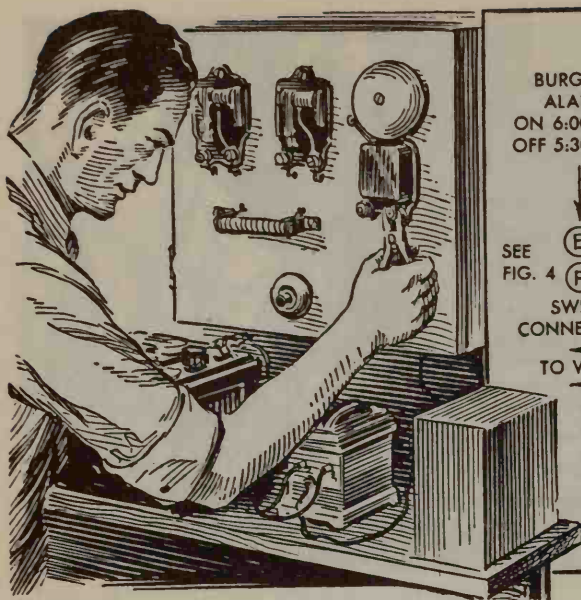




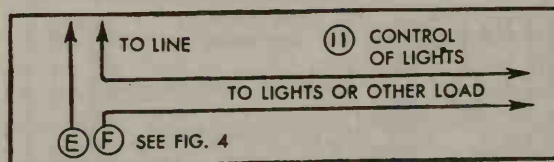
also be so arranged that any disturbance in a door or window will allow the rivet head to come to its normal position, thus altering the circuit. Fig. 7 shows the method of connecting the two kinds of traps to windows and doors. Open-circuit traps are connected in parallel, while the closed-circuit traps are connected in series. When the traps have been installed and connected respectively to the proper lead wires from the buzzers, the system is ready to be put into operation.

Before departing from the premises, clock No. 1 should be set so that its alarm will go off about 5 or 10 min. after the last person expects to be out of the premises. The second alarm should be set so it will go off before the arrival of the first person who is expected to reenter the premises. With the clocks thus set, and the alarm levers pulled up so that they will both go off, it is advisable to test the system to make sure that all of the traps are ready for operation. With all doors and windows in their respective positions, depress the pushbutton shown in Fig. 4. If everything is in order, the bell will not ring, but the armature of the second buzzer will be attracted by the coil. If the bell sounds, some of the open-circuit traps are short-circuited or some of the closed-circuit traps are open. An inspection of the traps will reveal which window or door has not been properly prepared for the night. If all of the doors and windows have been properly set the pushbutton can be depressed without ringing the bell. When everything is in order, you can leave the premises and lock the door. In the operation of such an arrangement as this, often it is advisable to equip the storage battery with a trickle charger such as is commonly used in battery-operated radios. By this means, the battery will be given a slow charge during the time the alarm is not in use. The relay will automatically cut off the charger at night. All of the connections for this arrangement are shown in Fig. 9.

Special use for the clock switches: Fig. 11 shows a simple scheme by which one clock may be used to turn lights on or off at any predetermined time. This is convenient when you want to leave the lights on and turn them off at 9 or 10 o'clock in the evening. Fig. 10 shows just one example of the kind of elaborate arrangement which

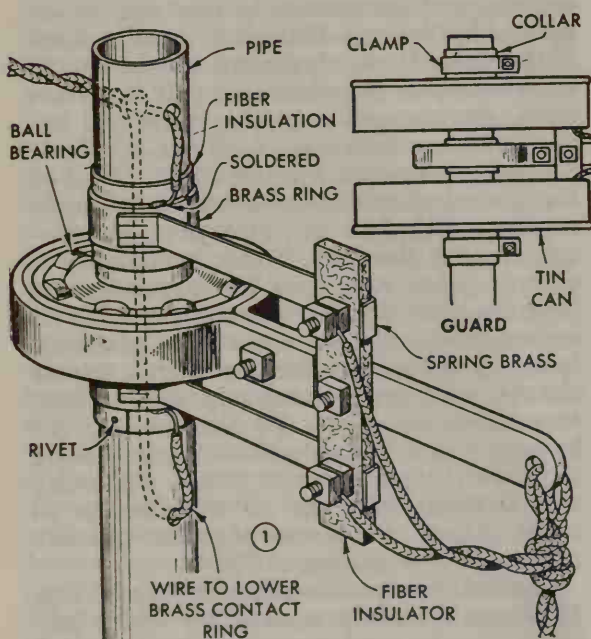


is possible with alarm clocks equipped with switches. In the example shown, three clocks are required. Each clock is equipped with double-pole, double-throw toggle switches. The heavy lines connecting the switch poles in the diagrams indicate the position of the switch before the alarms sound, and the blank spaces between the switch poles show the switch position after the alarm sounds. By this method, the

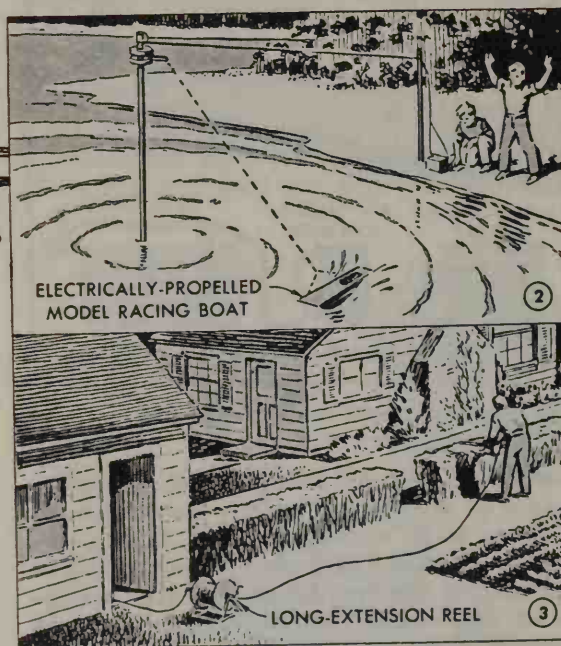


burglar alarm is connected to E and F as shown in Fig. 4, and the first and last clock will give the same protection as was previously explained.

ELECTRICAL ROTATING-CONTACT



Current can be passed through this rotating contact unit to operate model speed-boats, small machines that must be moved about to the work, lawn mowers, power-driven hedge shears and any other equip-

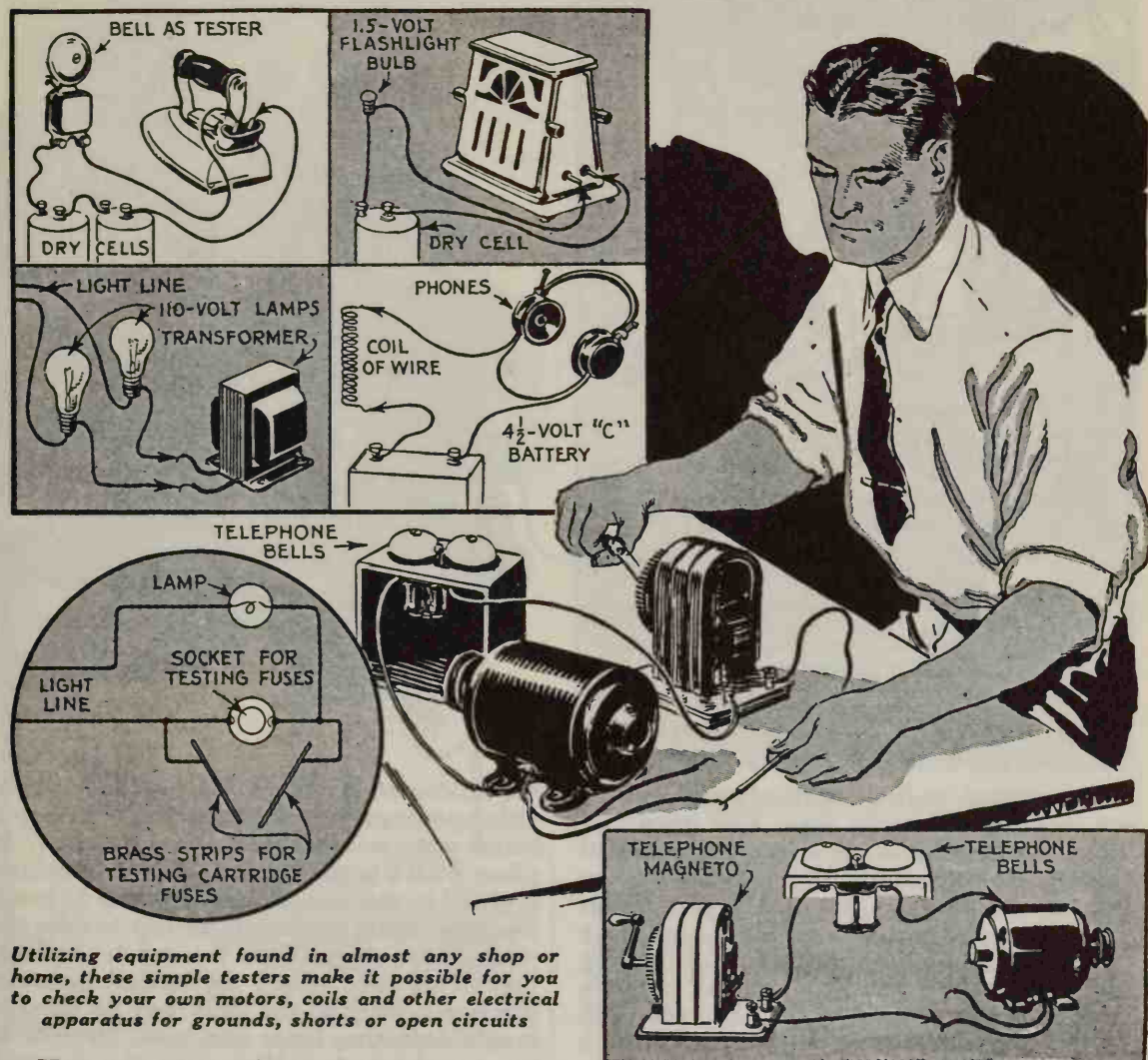


ment of a similar type which must operate at a considerable distance from the power source. No dimensions are given in Fig. 1 as the unit can be made any convenient size. It is necessary, however, that the spring-

brass contacts have a cross-sectional area equal to or greater than that of the line which supplies the current. Another important point in the construction is adjustment of the spring contacts so that they bear uniformly and yet lightly on the contact rings, thus avoiding any undue drag when the unit is rotating. Surfaces of the contact rings should be polished glass-

smooth and the ends of the spring-contact arms must be slit with a hacksaw as indicated. This helps to prevent arcing. For use on 110-volt current a guard made from a tin can is a good safety precaution. Fig. 2 shows the unit in use delivering current to a model speedboat running a circular course. Fig. 3 suggests delivery of power to electric hedge shears through an extension reel.

ELECTRICAL TESTER



Utilizing equipment found in almost any shop or home, these simple testers make it possible for you to check your own motors, coils and other electrical apparatus for grounds, shorts or open circuits

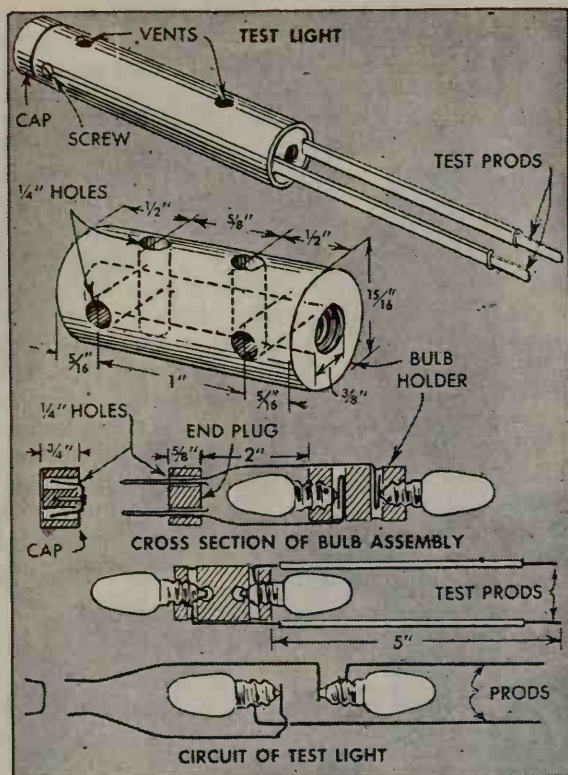
Here are six methods of making electrical testers from inexpensive equipment to locate grounds, short and open circuits. In the two upper details the methods are identical with the exception that the test results are audible on one and visible on the other. The bell will ring or the bulb will light when the test leads are connected together or to an unbroken circuit. The next left-hand detail shows a tester using two 110-volt lamps and operated from the lighting circuit. In this case also the lamps light when the leads are connected to a

closed circuit or in case of grounds. Brilliancy of the lights is a rough measure of the resistance in the circuit being tested. The adjoining detail shows a sensitive method which makes use of a pair of radio headphones. At the instant the leads are connected to a circuit in good condition there will be a click in the phones. In the circular detail is a tester for all kinds of fuses. The porcelain socket for testing plug fuses has its core removed and a piece of brass tubing substituted so that fuses

may be pushed in for testing. The brass strips mounted below the socket are for testing cartridge fuses. The most sensitive tester is shown in the lower right detail. A telephone magneto is used as the source of power, while a telephone bell serves as the indicator. This instrument is most use-

ful for locating grounds which would not show up with other testers. It is also handy when testing circuits having very high resistance but is not very satisfactory for coils of fine wire as it sometimes rings when a circuit is open if the wires in the coil are close together.

Electrician's Test Light Built From Stock Parts

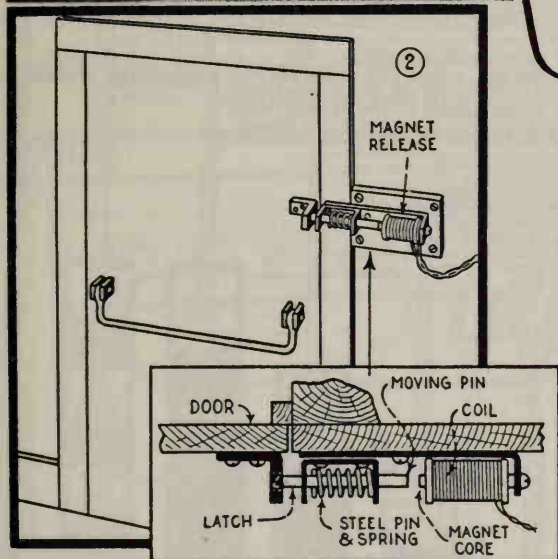
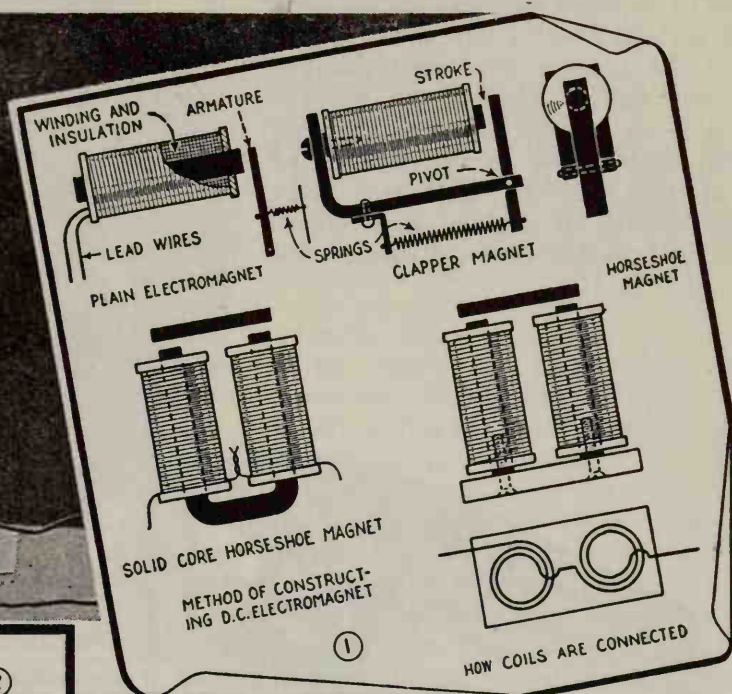


In addition to the regular flexible prods for locating defective fuses and open circuits, this test light has a novel and useful feature. A removable end cap allows the light to be plugged into a 110-volt outlet for testing fuses and locating grounds or open circuits without danger of grounding the source of power. The housing is made from a length of fiber tubing and the bulb holder is a round piece of wood cut from a shade roller. Two 110-volt candelabra-base bulbs are used. With care these can be turned into the holes in the ends of the bulb holder to form their own threads. The end plug supporting the plug prongs and cap can be cut from the same wooden stock as the bulb holder. Contact strips for the whole assembly are made from $\frac{1}{32}$ -in. spring-brass strips, $\frac{1}{4}$ in. wide. After assembling and wiring the parts, the assembly is forced into the fiber holder. Slip the end plug over the plug prongs and close the opposite end of



the holder with a fiber disk notched to provide openings for the test prods. The cap is fitted with a bent strip of metal held in place with a small brad. A disk of thin fiber is glued to the outer face of the cap to cover the small holes drilled in the cap to take the ends of the strip. When the cap is in place, the metal strip closes the circuit between the two prongs so the unit may be used to locate defective fuses and open circuits in the usual manner. Removing the cap and plugging the tester into a receptacle on the end of an extension cord allows the user to test grounded motors and other equipment for open windings and circuits without danger of grounding the "live" side of the circuit, as one lamp is in each lead. With the prods touching, both lights will be on at half brilliancy. However, contact with a grounded circuit will cause one light to be extinguished while the other reaches full brilliancy.

ELECTROMAGNET DESIGNING AND BUILDING



final performance of an electromagnet will vary slightly from the figured value because it is not possible to look at iron and tell exactly how effective it will be. To make the work as accurate as possible, values for four grades of iron will be given.

Direct-Current Magnets

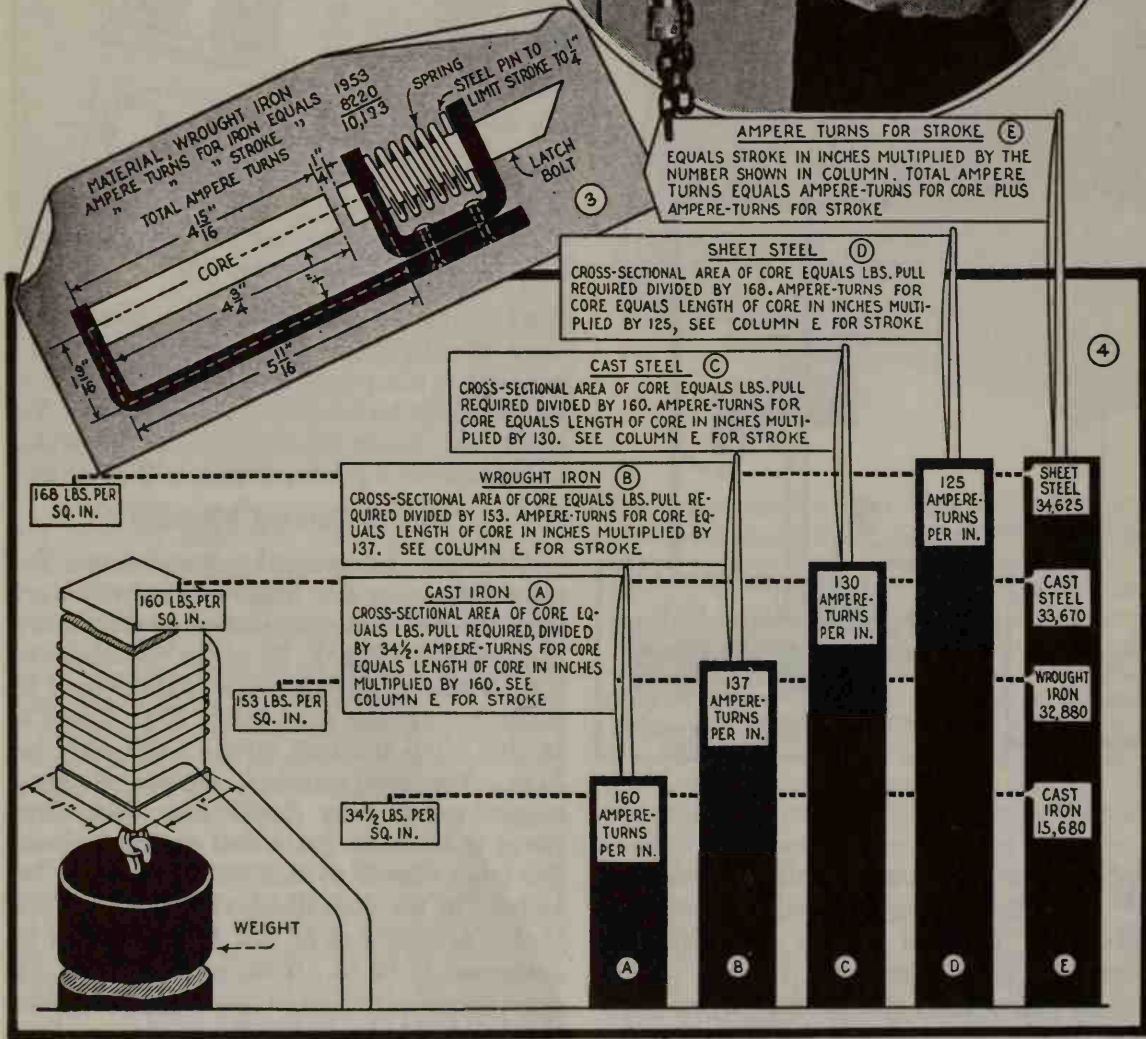
Although the general principles are the same for a.c. or d.c. magnets, we will start with the d.c. types, a number of which are illustrated in Fig. 1. In order to illustrate the method of design, we will show how to make a magnetic door latch, Figs. 2 and 3. In this latch the bolt stroke need only be $\frac{1}{4}$ in. For long strokes, simple electromagnets are very inefficient. The first thing to do is to get a coil spring to hold the latch closed so that its tension can be tested. In the case illustrated it was found that a pressure of 25 lbs. was required to compress it $\frac{1}{4}$ in. Now, as there will be considerable friction in operating the latch, it is advisable to design the magnet so that it will exert a pull of about 50 lbs.

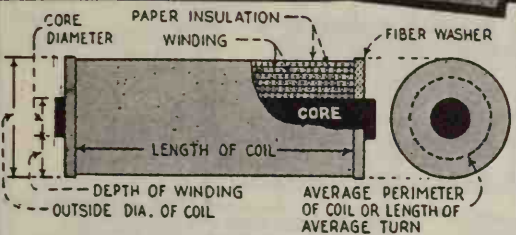
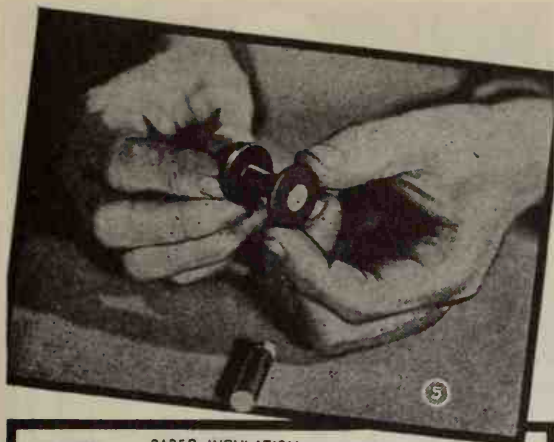
The latch can be forged conveniently from wrought iron so we will make our magnet core and frame from the same ma-

YOU can design and build electromagnets for almost any purpose without becoming involved in the difficulties of complicated mathematics. In this article we have brought the subject down to a few simple rules, which, if followed carefully, will give results that are entirely satisfactory.

However, like any other piece of electrical apparatus in which iron is used, the

terial. Consulting Fig. 4 we find from the flag B, labeled "wrought iron," that the cross-sectional area of the core is found by dividing the pull required, or 50 lbs., in our case, by 153. Performing the division we get .327 sq. in. It is convenient to use iron rod of standard diameter for the core, so we will select a size of rod which has the nearest area over this required value. Accordingly, we will use 3/4-in. rod for the core. Next we will again refer to flag B, labeled "wrought iron" in Fig. 4, and figure the number of ampere turns which we will need to give our magnet the





DIMENSIONS FOR ELECTROMAGNETS
 FOR DIAMETER OF CORE SEE FIG. 4. LENGTH OF COIL EQUALS 6 TIMES THE
 CORE DIAMETER. WINDING DEPTH EQUALS THE DIAMETER OF THE
 CORE. OUTSIDE DIA. OF COIL EQUALS 3 TIMES THE CORE DIA.
 AVERAGE PERIMETER OF COIL EQUALS 6.28 TIMES CORE DIAMETER

TO DETERMINE WIRE SIZE TO USE

- FIRST, MULTIPLY THE VOLTS TIMES 12,000
- SECOND, MULTIPLY AMPERE-TURNS TIMES AVERAGE PERIMETER OF COIL
- THIRD, DIVIDE THE SECOND ANSWER INTO THE FIRST ANSWER. THE RESULT IS THE WIRE SIZE IN OHMS PER 1,000 FT. FOR GAUGE NO. SEE WIRE TABLE

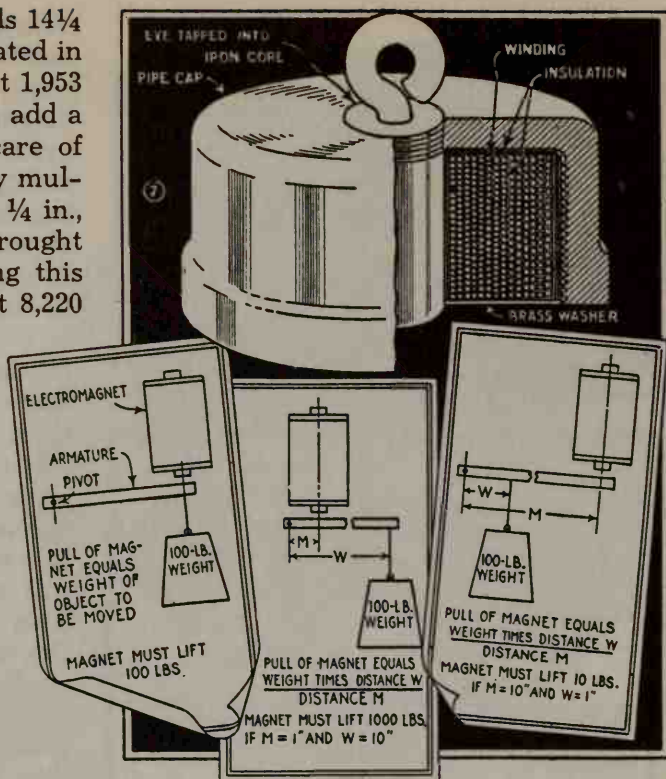
strength required. Here we find that the number of ampere turns required to magnetize the iron is found by multiplying the length of the magnet core by 137. Ampere turns is the name for the value found by multiplying the number of amperes flowing through a coil by the number of turns of wire in the coil. A coil, which passes 10 amperes and has 50 turns of wire, has 10 times 50, or 500 ampere turns. Similarly, a coil wound with 250 turns of wire and passing 2 amperes has 2 times 250 or 500 ampere turns. Before applying the formula to ascertain the number of ampere turns required, we will have to assume some reasonable value for the length of the coil and iron parts. A good rule to follow is given in Fig. 6. Applying this, our coil will be wound to a depth of $\frac{3}{4}$ in. This means that the outside diameter of the coil will be $2\frac{1}{4}$ in. Multiplying $\frac{3}{4}$ in. by 6 gives $4\frac{1}{2}$ in. as the length of the coil. To leave space for insulation, the iron core should be cut to a length of $4\frac{3}{4}$ in. Referring to the sketch of the magnetic latch shown in Fig. 3, we can readily add up the total length of the iron core. The length of the dotted lines represents the length we will have to measure. In other words, we must find out how far the magnetism

WIRE TABLE

B & S or A. W. G. Number	Ohms per 1000 Ft at Coil Temperature	Circular Mils	TURNS PER SQUARE INCH				OHMS PER CUBIC INCH			
			Enamel Covered	Single Cotton Covered or Double Silk Covered	Double Cotton Covered	Enameled and Single Cotton Covered	Enamel Covered	Single Cotton Covered or Double Silk Covered	Double Cotton Covered	Enameled and Single Cotton Covered
8	764	16510								
9	963	13090				84.8	.00765	.00725	.00662	.00704
10	1.215	10380	92.2	87.5	80	105	.0121	.0115	.0102	.0110
11	1.532	8234	116	110	105	131	.0193	.0181	.0160	.0173
12	1.931	6530	146	136	121	162	.0308	.0283	.0250	.0271
13	2.436	5178	184	170	150	198	.0493	.0443	.0385	.0417
14	3.071	4107	232	211	183	250	.078	.0697	.0592	.0665
15	3.873	3257	293	262	223	306	.122	.107	.0907	.102
16	4.884	2583	365	321	271	372	.194	.168	.139	.157
17	6.158	2048	460	397	329	454	.304	.263	.213	.242
18	7.765	1624	572	493	399	553	.477	.397	.318	.370
19	9.792	1288	718	592	479	725	.774	.657	.530	.615
20	12.35	1022	912	775	625	895	1.23	1.01	.806	.957
21	15.57	810	1150	940	754	1070	1.91	1.54	1.22	1.43
22	19.63	642	1430	1150	910	1300	3.01	2.38	1.82	2.20
23	24.76	510	1780	1400	1080	1570	4.78	3.64	2.70	3.37
24	31.22	404	2240	1700	1260	1910	7.66	5.61	4.10	5.18
25	39.36	320	2820	2060	1510	2300	12.1	8.50	5.95	7.82
26	49.64	254	3560	2500	1750	2780	19.0	13.0	8.66	11.9
27	62.59	202	4420	3030	2020	3350	30.2	19.8	12.5	18.1
28	78.93	160	5580	3670	2310	3900	47.3	29.5	18.5	26.7
29	99.52	127	6900	4300	2700	4660	75.2	43.6	26.2	40.3
30	125.5	101	8700	5040	3020	5280	116.	64.0		57.0
31	158.2	80	10700	5920		6250	185	96.5		85.5
32	199.5	63	13500	7060		7360	293	140.		127.
33	251.6	50	17000	8120		8310	460	209.		181.
34	317.7	40	21100	9600		8700	721	300.		266.
35	400.1	32	26300	10900		10700	1110	422		370.
36	504.5	25	32000	12200			1740			
37	636.2	20	39800				2710			
38	802.2	16	49400				4250			
39	1012	12	61200				6660			
40	1276	10	76100							

must travel through iron. This totals $14\frac{1}{4}$ in. Multiplying this by 137, as indicated in Fig. 4, under "wrought iron," we get 1,953 ampere turns. In addition, we must add a number of ampere turns to take care of the stroke. This amount is found by multiplying the length of the stroke, or $\frac{1}{4}$ in., by the number shown opposite "wrought iron" under the flag E. Multiplying this number, or 32,880, by $\frac{1}{4}$ in. we get 8,220 as the number of ampere turns to be added. Adding 1,953 to 8,220 we get 10,173 as the total number of ampere turns required for the coil. This same procedure may be used for any d.c. magnet. In all cases the total length of the iron through which the magnetism must pass to make a complete circle, must be measured. In case a core is used which does not have a return path for the magnetism, only the core length and length of stroke are considered in figuring the ampere turns required for magnets having short strokes. For long strokes, solenoids or plunger magnets should be used.

Next we figure the size of wire required to wind the coil. Fig. 6 shows a simple rule for doing this. After figuring the average perimeter, which, according to the rule, is 6.27 times the core diameter, or in this case 4.71, we can then determine the wire size to use. If the coil is to be operated on 110 volts d.c. we first multiply this voltage, or 110, by 12,000, which gives us 1,320,000. Next we multiply the total number of ampere turns found as above, or 10,173, by the average perimeter, which we have just figured, or by 4.71, which gives us 47,915. Then we divide this number into 1,320,000, which gives us 27.55 ohms as the resistance of 1,000 feet of the size wire we need. Referring to the wire table, we find that this resistance corresponds to a size of wire between Nos. 23 and 24. We may choose either of these. The larger, or No. 23 wire, will increase the strength of the magnet slightly and cause it to become somewhat hotter; however, as this magnet is to be used intermittently, No. 23 wire may be used without danger of overheating. In winding the coil figured by these methods, it is not necessary to count the turns of wire, as



the selected size of wire will produce the correct number of ampere turns regardless of the exact number of turns wound. Changing either the voltage or the coil diameter will prevent the coil from performing as it should. The coil may be increased in length or shortened without changing the number of ampere turns or strength. If the coil is shortened it will run hot and if it is lengthened it will run cooler and consume less current but will deliver the same pull. Washers of suitable size to slip over the core tightly as in Fig. 5, should be made from bakelite or fiber. The outside diameter of the washers should be slightly over the outside diameter of the coil. With the end washers in place, the iron core between them is covered with two or three layers of heavy brown paper. This should be held in place with shellac, which also improves the insulating quality. One layer of paper should be placed between every two or three layers of wire for added insulation. Wire with any type of insulation may be used without changing the ampere turns in the coil. When the coil is finished, it is a good idea to coat it with shellac as shown in Fig. 14.

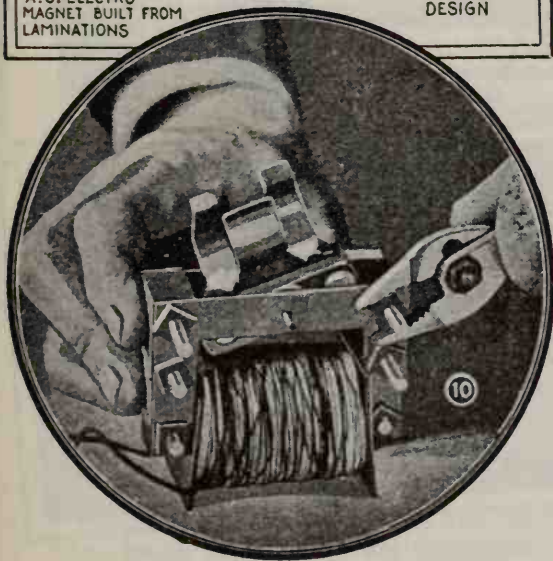
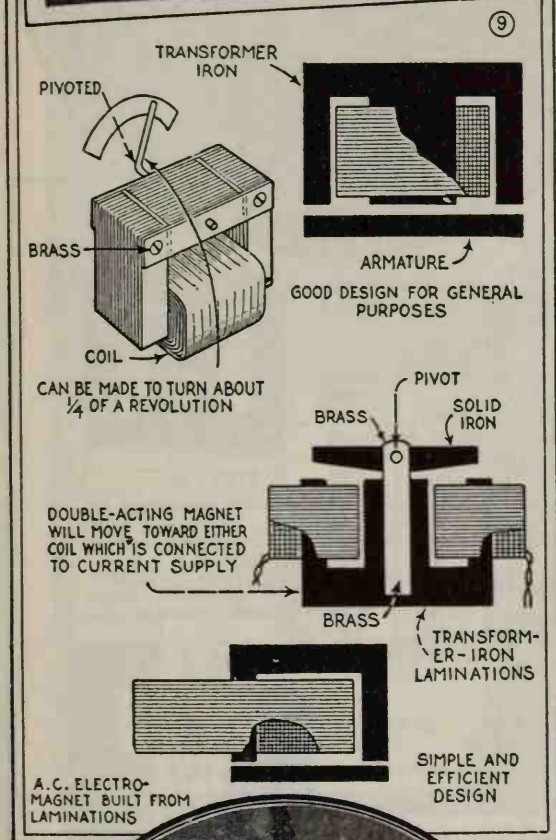
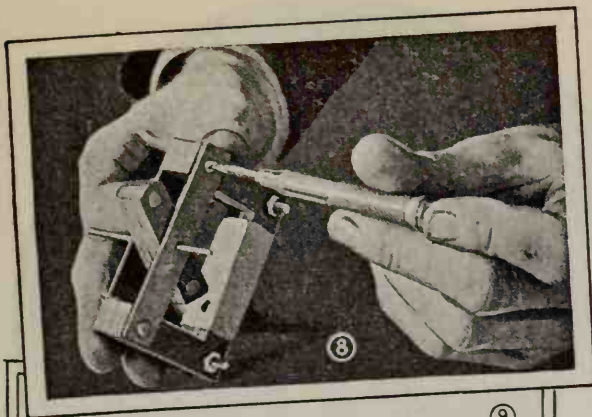


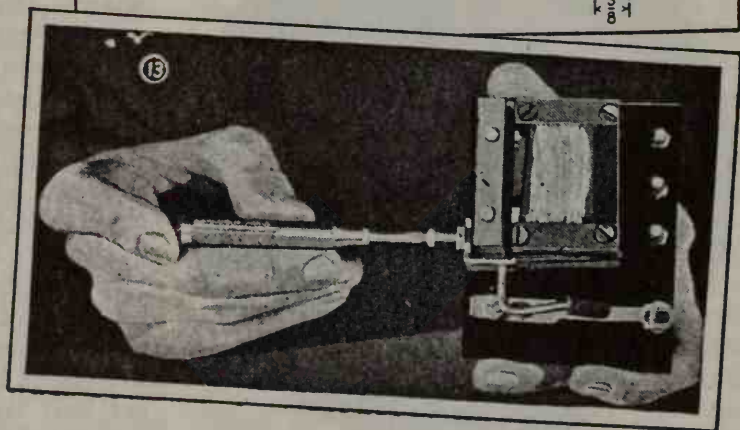
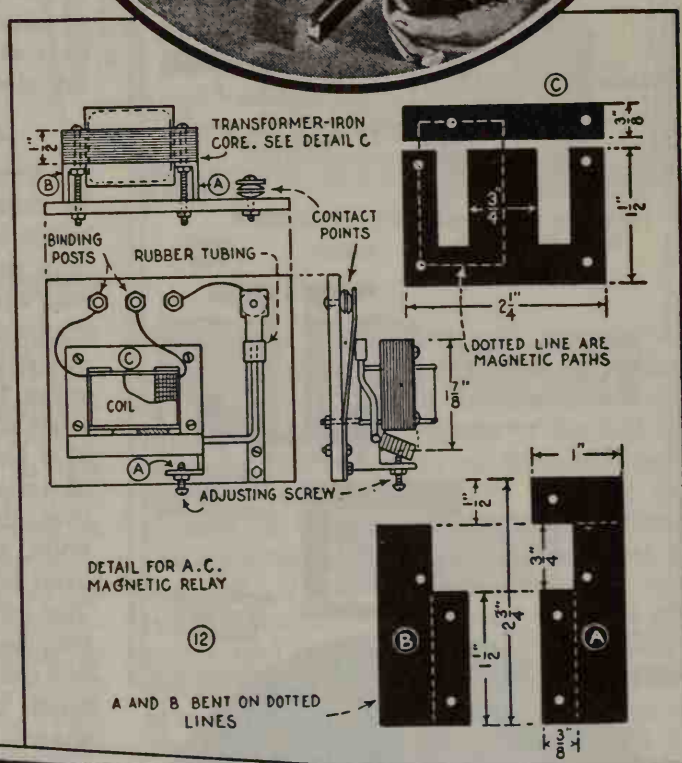
Fig. 7 shows a simple design for a lifting magnet. The frame for this type of magnet may be built from a pipe cap. The core is turned from a piece of cast iron or steel. The number of piece of ampere turns required for a magnet of this type is figured exactly as explained above except that no allowance is made for stroke. Other special types of magnets may be worked out by similar methods. It must be remembered that enclosed windings or short coils tend to pull more amperes and therefore get hotter than long-exposed coils that can radiate their heat. Magnets used to operate systems of levers must be designed to allow for the variation in pull required due to the lever system. Some simple methods of figuring the pull required of lever magnets are given in the three details which are shown below Fig. 7.

Alternating-Current Magnets

Alternating-current electromagnets may be designed for many purposes if care is taken to design the metal parts so that the iron makes a complete circuit around the coil when the magnet arm is closed. Plain magnets without a return path for the magnetism are not satisfactory for a.c. The cores for a.c. magnets must be built up from sheets of steel the same as the core of a transformer. Fig. 9 shows a number of a.c. magnets. Silicon steel or stovepipe iron, tightly assembled by means of stove bolts, as shown in Figs. 8 and 10, may be used for the cores of this type of magnet. The moving part, or clapper as it is called, may be made from solid metal if it is small, but the core upon which the coil is wound must be built up from laminations as shown; otherwise trouble will be experienced from excessive heating.

To make clear the application of simplified methods for designing a.c. magnets, we will construct an a.c. magnet suitable for closing an electrical switch. Magnets that are arranged to close or open electrical switches are called relays. Inasmuch as the core from an old transformer is usually available we will use one of these for our magnet. A sketch of the core together with the mechanical arrangement is shown in Figs. 12 and 13. From the sketch we can see that the length of the iron face that will be effective in giving pull to the mag-

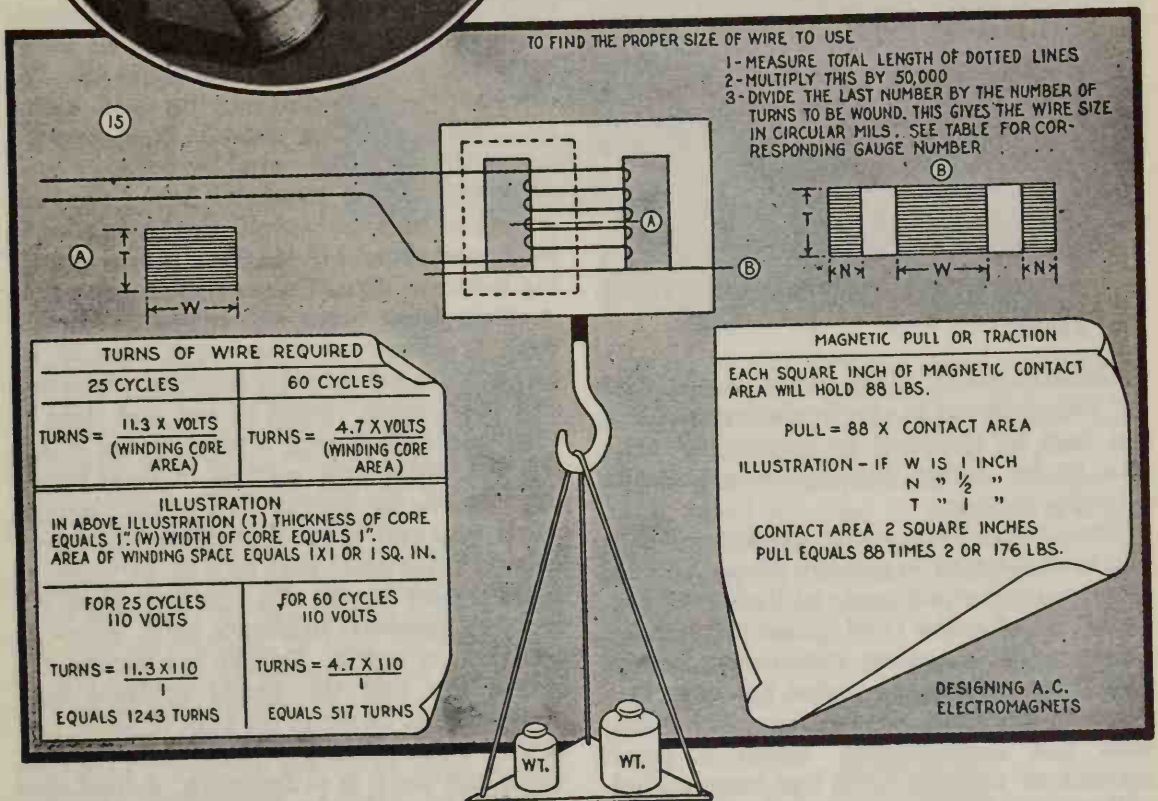
net is divided into three parts. The outside legs are $\frac{3}{8}$ in. wide and the center leg is $\frac{3}{4}$ in. long. Adding these together gives $1\frac{1}{2}$ in. as the total length of the effective pulling surface. Multiplying this length by the thickness of the core, or $\frac{1}{2}$ in., we get $\frac{3}{4}$ sq. in. as the cross-sectional area of the core that is effective in giving pull to the magnet. For a.c. magnets it is safe to figure that each square inch of pull surface will produce a pull of 88 lbs. The pull of our magnet will therefore be $\frac{3}{4}$ multiplied by 88 or 66 lbs. As this value is ample for our purposes we will use the core as it is. The number of turns of wire required for the coil will depend upon the voltage to be used and upon the frequency or cycles of our current supply. If our magnet is to be operated on 110 volts, 60 cycles, a.c., we see from Fig. 15 that the turns are figured by multiplying the voltage by 4.7 and then dividing this answer by the cross-sectional area of the core. The cross-sectional area of the core in this case is the cross-sectional area of the leg upon which the coil is wound. Referring to Fig. 12 we see that this leg is $\frac{3}{4}$ in. wide and $\frac{1}{2}$ in. thick. Multiplying these together gives us $\frac{3}{8}$ or .375 sq. in. as the cross-sectional area. Then the turns are found by multiplying the voltage, or 110 by 4.7 which gives us 517, and then dividing this number by the cross-sectional area, or .375, which gives us 1,352 as the required number of turns. The method of figuring the wire size is also indicated in Fig. 15. Applying this rule, we first measure the length of the shortest path through which the magnetism must pass. This is indicated by dotted lines in Fig. 12, and totals $4\frac{7}{8}$ or 4.875 in. Applying the rule for wire size, we first multiply 4.875 times 50,000, which gives us 243,-





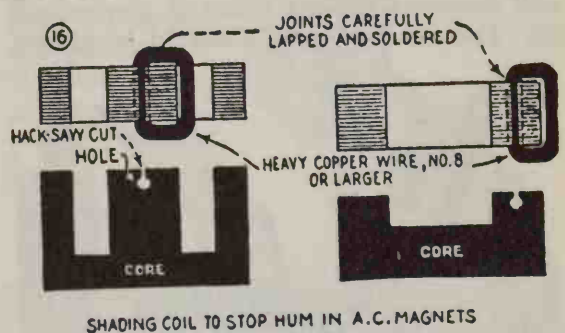
what is termed a "shading coil," which is simply a turn of very heavy copper wire wound into a slot in the core as shown in Fig. 16. Either of the methods shown is effective. For the magnet just described a piece of No. 8 or larger copper wire should be used. The ends should be carefully lapped together and soldered as shown in Fig. 11. Care must be taken to completely sweat the splice together, otherwise it will not be effective.

These methods for designing magnets may be applied to almost any kind of problem. In doing this kind of work it is



750. Dividing this number by the turns, or by 1,352, gives us 180 circular mils as the wire size required. Referring to the wire table, we find that this falls between Nos. 27 and 28. As we do not require the full power of the magnet for operating the relay, we will select the smaller wire size, or No. 28. The coil may be wound on a form and installed on the core by the same methods as are used in transformer construction. Before the coils are fitted over the cores, the latter are covered with insulating paper.

Alternating-current magnets tend to hum badly unless they are equipped with



best practice to figure out the design you need and then make minor variations by experimenting until you get exactly what you want.

ELECTROPLATING METAL



CHEMICALLY clean work is the first requirement in electroplating, and this can best be obtained by putting all articles to be plated through a systematic cleaning routine.

First, wash the work in gasoline or carbon tetrachloride to remove grease and oil. A mixture of equal parts of these two solvents is effective and practically non-inflammable. Lacquer remover is necessary if the work to be plated has been finished in that manner. A final scrubbing with hot soapsuds, to which a small amount of washing soda has been added, will remove the last trace of grease and oil. The cleaned article should be rinsed

first in hot and then in cold water to rid it entirely of soap. Second, if the work is of iron or steel, all scale and oxide must be removed by pickling in a sulphuric-acid bath. This consists of one part of commercial sulphuric acid and ten parts of water by volume. Do not pour the water into the acid, but pour the acid into the water slowly. This should be done in a stoneware crock. Glass is not suitable, because considerable heat is generated when the acid is poured into the water. Cast iron should be dipped several times, rinsing and brushing between dips. To remove heavy oxide coatings from brass and copper a "bright dip" is effective. The work should be quickly dipped into the solution, removed, and thoroughly rinsed in hot and then in cold water. Too long a time in the bright dip will cause deep pitting. A good bright dip is made by adding 1 lb. of commercial nitric acid and $\frac{1}{2}$ oz. of commercial hydrochloric (muriatic) acid to 3 qt. of water in a stoneware crock. To this add slowly 2 lb. of commercial sulphuric acid. Allow to cool before using. Crock containing the bright dip and the pickle solution may conveniently be set in the sink while in use. If cold water is allowed to run into the sink while the work is progressing, spilled acid will be diluted and safely carried away before it can attack the plumbing. The bright dip will give off nitric-oxide fumes while it is in use. These fumes may be removed by proper ventilation. The surface of soldered or brazed work usually has a hard scale, together with crystallized borax or flux. This can be removed by pickling the work in 1 gal. of water to which has been slowly added 1 oz. of sodium dichromate and 10 oz. of sulphuric acid.

After the scale has been removed by this treatment, the work may be bright-dipped as previously described. In using any of these chemical cleaning baths, it is important to rinse the work first in boiling-hot, then in cold water im-





mediately after its removal from the bath. The hot water will aid in forcing the metal to give up any hydrogen gas which it has absorbed and which would cause brittle electroplates. Besides, pitting will result if any acid is left on the work.

The third step in cleaning is that of polishing and buffing the surface of the work to render it smooth and lustrous. In the case of castings, it may be necessary to use a grinding wheel before the work is finished with finer abrasives. The plater must decide for himself just how many grades of abrasives are to be used in the polishing operations. Emery powder is available in a large variety of fineness. For most purposes No. 120 emery is adequate for the first polishing. If the powder is used, it should be run onto a cloth buffing wheel which has been previously sized with a good grade of glue. It is more convenient to buy the abrasives in stick form (abrasive mixed with a suitable grease binder). In this form they vary from fairly coarse, such as No. 120, to very fine, such as No. 150. To use, the stick abrasives are brought in contact with a rotating cloth buffing wheel. The heat generated will melt a portion, which will adhere to the surface of the cloth. The work is polished by moving it in contact with the wheel.

Finer grades of abrasive may be used progressively until the surface has the desired polish. Many abrasives other than emery are available, and most of them can be obtained in stick form. A number of these, listed in order of fineness, are emery, tripoli, pumice, crocus, lime, and jewelers' rouge. The last is the finest and softest. The importance of polishing and buffing will be realized when it is understood that the plated work will be no smoother than the polished work before the plating.

After the surface of the work has been buffed and polished to the desired finish, the film of polishing grease must be

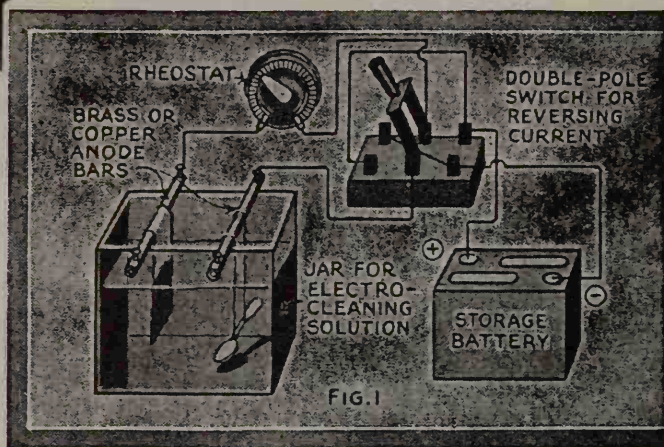


WEIGHING COPPER
CARBONATE FOR
ELECTROPLATING BATH



should be used as hot as possible. When the proper cleaner has been selected, the work should be suspended in it and the rheostat adjusted until a large volume of gas is being liberated from the work suspended from one of the rods. Reverse the current every few seconds with the switch. The work need be left in the electro-cleaner only a few minutes. If it contains solder, the time must be very short to prevent its being dissolved. Remove the work and rinse in hot and cold water. If, after thorough rinsing, the water tends to form globules on the surface rather than flow smooth, the cleaning is incomplete. In this case, it will be found most satisfactory to scrub the work with finely powdered lime. Then, after rinsing, repeat the electro-cleaning operation, and after the work has been thoroughly cleaned, dip it in the acid or bright dip and rinse as before.

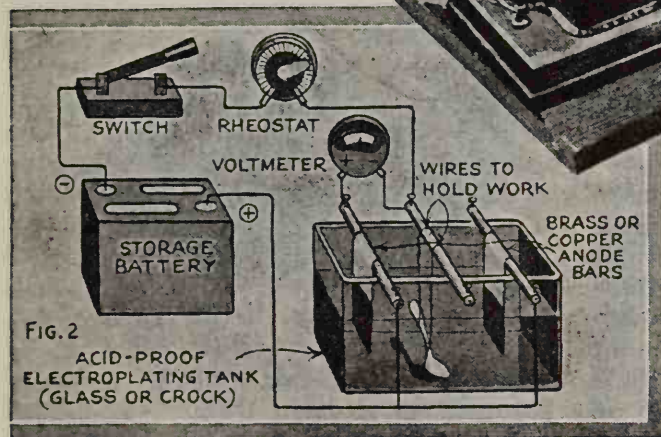
removed. This is best accomplished by electro-cleaning. This is carried out by hanging the work from copper or brass rods in an electro-cleaning solution in a crock or battery jar. Two rods must be used. Work may be hung from both rods, but if only one piece is to be cleaned, any piece of scrap lead or iron may be hung from the other rod to complete the circuit. The supporting rods are connected to a storage battery and rheostat through a reversing switch, as in Fig. 1. The proper cleaning solution to use depends upon the kind of metal of which the work is made. For iron or steel, dissolve one-half can of lye and a quarter of a bar of good laundry soap in 1 gal. of water. For brass and similar alloys, dissolve 4 oz. of washing soda, 2 oz. of trisodium phosphate, one-eighth of a bar of soap and $\frac{1}{2}$ oz. of lye in 1 gal. of water. For articles made from aluminum or zinc, use a solution made by dissolving 3 oz. of washing soda and 3 oz. of baking soda in 1 gal. of water. All of these solutions



The work is now ready for its first electroplating bath. If the solution is not ready, the work should be kept suspended in clean water. This will prevent oxidation and accumulation of dirt, either of which is ruinous to plating. To prepare a good chromium-plating solution, dissolve 33 oz. of chromic acid in 1 gal. of water. To this solution add $1\frac{1}{2}$ fl. dr. of concentrated sulphuric acid. This solution is very corrosive to skin and organic matter. It should be kept in a glass-stoppered bottle and protected against spilling or breakage. If desired, you can use one of the patented chromium-plating solutions which can be purchased ready for use.

They are very effective and the cost is not high. Although this solution will plate fairly well at room temperature, it works better if it is kept at a temperature of about 100° F. This may be accomplished by setting the glass or stoneware plating tank on blocks of wood in a larger container, such as a pail, in which enough water is kept to surround it as shown in one of the photographs. The assembly can then be heated without danger of breakage or overheating. A thermometer can be immersed in the water surrounding the plating tank. The chromium comes from the solution; therefore inert anodes of sheet lead or steel are used. These are suspended from heavy brass or copper bars resting across the plating tank and connected directly to the pos-

CHROMIUM-
PLATING BATH
WORKS BEST
AT 100° FAHR.



acid fumes which will be liberated, and the switch is then closed. The rheostat is adjusted until the voltmeter reads about 4 volts. After a few seconds, the current is turned off and the work examined for plate. If no plate has formed, it will be necessary to vary the voltage up and down until results are obtained. Some patience will be required here, as

the temperature, the purity of the chemicals and the kind of work all have influence on the formation of the chromium plate. In four to five minutes a chromium plate adequate for most purposes can be deposited. If the plate does not form on the work directly under the suspension wires, the wires must be shifted so as not to interfere. If a defective plate is produced, it may be quickly stripped off by immersing the work in dilute hydrochloric (muriatic) acid. After rinsing, another trial may be made. Chromium may be plated directly on iron, but the deposit is likely to be porous and will offer little

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protection against corrosion. When mechanical durability, such as is needed for golf clubs or tools and dies, is desired, this method should be used. For protection against rust and for the best finish, undercoats of copper and nickel are necessary. For decorative purposes steel articles should first be plated with a heavy coat of copper, then with a medium-heavy plate of nickel. Chromium may then be plated over the nickel in the same manner as before. To produce the copper plate, connect the apparatus exactly as for chromium, except that pieces of sheet copper are to be used as anodes. The solution is the dangerous cyanide-copper solution. It is a deadly poison, and its fumes must not be inhaled. If any abrasions exist on the hands, wear rubber gloves while handling it. It can be absorbed through cuts, the eyes, or other tissues; therefore prepare it in a draft which carries the fumes away from you and avoid contact with it. To prepare the solution, dissolve 1 oz. of sodium carbonate in 1 gal. of water. Then add 3½ oz. of sodium cyanide (poison) and stir with a stick until dissolved. Weigh out 3 oz. of copper cyanide (poison). To a small portion of the above solution, add the copper cyanide and work it into a paste with a stick. Add this paste to the rest of the solution and stir carefully until it dissolves. Add ⅛ oz. of hypo, and the solution is ready to use. It should be used at room temperature. The rheostat should be adjusted so that the voltmeter reads about 4 volts. Be sure that the work is well rinsed before placing it in this bath; also avoid spilling acid or other solutions in the bath, as this would cause the liberation of large quantities of hydro-cyanic-acid gas. An immersion of thirty minutes will produce a good plate on the work.

After plating with copper, rinse the work thoroughly and nickelplate it in a solution made by dissolving 12 oz. of nickel sulphate, 4 oz. of nickel chloride and 2 oz. of boric acid in 1 gal. of water. Use sheets or bars of pure nickel as anodes. Adjust the rheostat until the voltmeter reads 5 volts. After a few minutes, readjust the rheostat without opening the switch until the voltmeter reads a little less than 2 volts. For a heavy plate, let the current flow for about forty min-

utes; for a thin plate, fifteen minutes will suffice.

The completed nickelplate should be rinsed thoroughly, dried and polished with gentle pressure, using fine Vienna-lime paste on a soft muslin buffing wheel. After the nickel is polished, the work should be rinsed in hot and cold water and electro-cleaned as before to remove the polishing grease. It should then be immersed in the acid dip and rinsed again with hot and cold water. The work is now ready for the chromium, if this is desired. Plate on the chromium as previously described for three to four minutes. After rinsing, the chromium may be polished to a brilliant luster with any good grade of chromium-coloring paste applied with a soft muslin buffing wheel. Chromium may be effectively plated onto well cleaned copper. Brass, zinc and silver articles should be nickelplated before attempting to plate them with chromium. The nickelplate in these cases should be polished exactly as for steel.

If you intend to do considerable work in plating, standard commercial anodes may be used, obtainable at any electroplating-supply house, or homemade sheet-metal anodes can be employed. Convenient hangers from which they are suspended are made from lengths of brass tubing of sufficient strength to hold the anodes. To make it easy to connect your wiring to them, drill and tap the ends for a small 6-32 machine screw. Bottle labels of paper, which may be quickly eaten off by acid, can be protected from the action of the acid by coating them with melted paraffin.



ELECTROPLATING

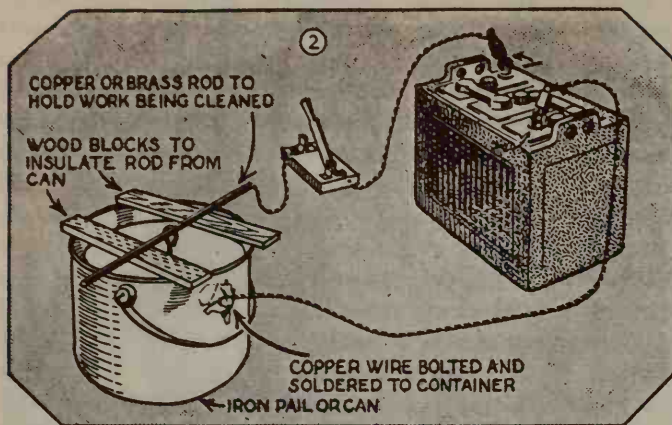
with Gold and Silver



GOLD and silver can be easily plated onto copper or brass. Articles made of other metals should be thoroughly cleaned and covered with a thin coat of copper before any attempt is made to gold or silverplate. This preliminary plate, called a copper strike, is best done in an alkaline cyanide (poison) bath, for three reasons: First, the acid copper-sulphate plating bath will not plate copper onto some metals; second, the cyanide bath may be made of such a composition that it will act both as a final cleaner and as a copper-strike bath at the same time, and lastly, the plater will avoid waste of the gold and silver solutions because an article completely covered with a thin coat of copper is chemically clean so that gold or silver will adhere. If copper has not completely covered the article, the work has not been thoroughly cleaned, and gold or silverplate will not form on the places bare of copper. The cure for this is obvi-

ous and simple. It is only necessary to remove the copper plate by reversing the current for a few seconds, and to give the work another copper strike. Before the strike, the work should be freed from burrs and roughness by grinding and filing. Buffing with emery and fine jewelers' rouge to produce the desired finish should be done before the work is put into the combined strike and cleaning solution, remembering that the final finish will be no smoother than it was before plating.

A combined copper strike and cleaning solution, which is used commercially, can be made by dissolving sodium cyanide (deadly poison), $\frac{3}{4}$ oz., and caustic soda (caustic poison), 4 oz., in $\frac{1}{2}$ gal. of water. In handling the poisonous cyanides and the solutions made from them, great care should be exercised to prevent their coming in contact with the skin. They are readily absorbed—and with fatal results—at a skin abrasion or by mucous membranes, and therefore the use of rubber gloves is advised. Work with these solutions should be carried on in a well ventilated room so that a draft is created to carry any fumes (hydrocyanic acid, a deadly poison) away from the worker and



out of doors. Dissolve the cyanide in the water first; then add the caustic soda and allow it to dissolve. When these are in solution, add copper cyanide (poison), $\frac{1}{4}$ oz., and stir carefully with a stick until all is dissolved. Place the solution in an iron or steel container. With a piece of heavy copper wire connect the positive pole of a 6-volt storage battery to the bucket or pail. This may be best done by drilling a small hole in the bucket near the top and fastening the wire with a brass machine screw and washers. The connection should be made tight, as it will have to carry a heavy current. Another piece of heavy copper wire is securely attached to the negative pole of the battery. This wire should be of such length that the work may be suspended from the loose end and immersed in the solution, as indicated in Fig. 2. It will only require 30 to 40 seconds for the cleaning operation and the copper strike. Large quantities of gas bubbles will be violently liberated on the surface of the work. These bubbles are highly efficient in scouring the work and removing foreign matter, which would interfere with plating. As rapidly as a particle of dirt or grease is removed by the gaseous ebullition, a thin coat of copper forms on the surface. This cleaning and plating solution will require replacement when it becomes sluggish in action, because no copper is added to it to replace that which is deposited. Replacement need not be frequent, however, on account of the small amount of copper which will be used in each cleaning operation. Waste cyanide solutions may be run away through the sink together with copious quantities of water. Under no circumstances should any

kind of acid be allowed to come in contact with cyanide or its solutions, as this would cause the liberation of deadly hydrocyanic-acid fumes.

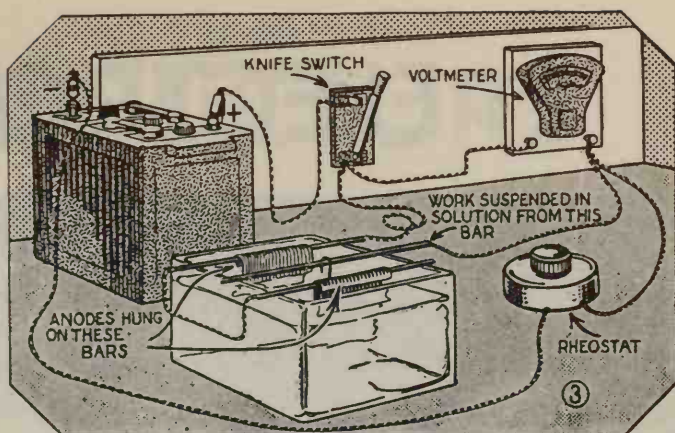
When the work has received its coating of copper, it should be immersed in boiling water without being touched by the hands. After this rinsing, the work is suspended by the copper wire in a container of clear water until the gold or silver solution is ready. Clean copperplated work will remain clean if it is kept immersed in

clear water and is not touched by the hands or other objects. Silver may be plated directly after the copper strike, but it is generally desirable to dip the work into a mercury "quicking" solution for a few minutes just before it is placed in the silverplating bath. A good quicking solution is made by dissolving mercurous nitrate, $\frac{3}{4}$ oz., in water, $\frac{1}{2}$ gal. To this is added concentrated nitric acid (poison), a few drops at a time and with constant stirring until the solution becomes clear. The solution is stirred with a wooden paddle or glass rod, and should be kept in a glass container, as it will attack metal. To use it, the clean copperplated work is immersed in the solution by a copper wire attached to the work. In a few seconds, the work will take on a dull grayish-white appearance, due to a coating of mercury deposited on its surface. The amalgam of mercury and copper makes an exceptionally good base for the deposition of a firm, adherent silverplate. The work should never be allowed to remain too long in the quicking solution, because too much mercury in the amalgam is detrimental to the silverplate.

Silver and gold solutions should be used in glass or stoneware containers. To make the silverplating solution, dissolve sodium cyanide (poison), 2 oz., in water, 1 qt. To this add silver chloride, $\frac{3}{4}$ oz., and stir with a stick until dissolved. Sheets of silver or silver foil are suspended from the positive bars, which are laid across the plating tank, as indicated in Fig. 3. If sheet silver or silver foil is not available, a few ordinary arc carbons may be used instead, but the latter method is less satisfactory as the solution rapidly deteriorates. The

rheostat shown in Fig. 3 may be an old radio-filament rheostat. When the work has been suspended in the solution, close the switch and adjust the rheostat until the voltmeter reads a little less than one volt. When a silverplate of suitable thickness has been produced, the work should be thoroughly rinsed in warm water and dried in a pan of warm sawdust.

For goldplating prepare a bath by dissolving neutral gold chloride, $\frac{3}{4}$ oz., and potassium cyanide (poison), 2 oz., in 1 qt. of distilled water. This solution should be allowed to stand for several days before it is used. The same method is followed as in the silver bath. The anodes—the electrodes suspended from the bar connected to the positive pole of the battery—should be gold foil or hard, coreless electric-arc carbons. Goldplating solution deteriorates in use with carbon anodes and accordingly will have to be replaced from time to time. When the work and the anodes have been suspended in the solution, close the switch and adjust the rheostat until the voltmeter reads about 1.5 volts. The color of the goldplate produced can be varied by changing the voltage slightly. It is impossible to give exact data on the colors and tones of plate, as there are so many other factors, such as purity of chemicals, size of anodes, and the space between the anodes and the work which also have a decided effect upon the color of the plate. Gold, plated over copper, or after the copper strike recommended here, will be of a reddish tone. If this is not desired, the work may be nickelplated after the copper strike and then goldplated. Gold over nickel produces a very beautiful light-yellow color, characteristic of fine gold. Goldplating may be done satisfactorily at room temperature, but a greater variety of tones and shades can be produced if the bath is heated. This heating should be done by immersing the plating tank in a bucket of water kept warm by a burner. The temperature of the water in the bucket should not be allowed to rise beyond 170° F. Care must be taken to avoid the inhalation of poisonous hydrocyanic-acid fumes, which may be liberated while the solution is hot. Green goldplate is made by adding



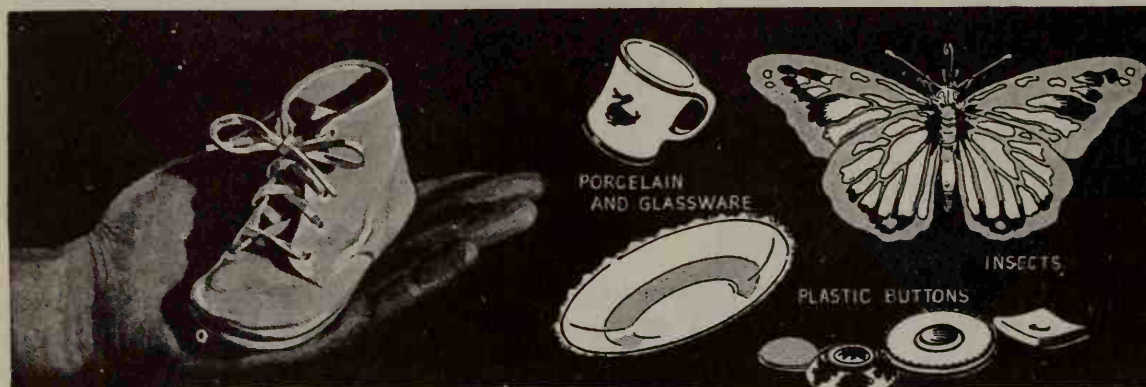
a small quantity of the silverplating solution previously described to the gold bath. To obtain the desired color, add the silver solution to the gold bath in small quantities (about $\frac{1}{2}$ oz. at a time). Red gold is produced by dissolving a small quantity of copper acetate in the gold bath. A very small quantity (a little on the point of a knife) is worked into a paste with a few drops of the gold solution, and is then added to the bath by stirring.

Gold and silverplated work may be polished with cloth buffers and jewelers' rouge. When the luster has been developed, the work may be cleaned with household ammonia and polished with a felt buffer to produce the final finish.

IMPORTANT

In plating with gold and silver where it is necessary to use deadly poisonous cyanides, great caution should be exercised to prevent accidents. Handle the chemicals so that the solutions will not spatter. These cyanides can enter the body through the eyes, skin abrasions and, perhaps through the pores of the skin after a period of time. When cyanide comes in contact with acids, deadly hydrocyanic-acid fumes are generated. Do the work where a draft will carry all fumes from the plating bath or hot cyanide solutions out of doors. To dispose of the solutions, pour them into a sink into which a quantity of lye water has just previously been poured. Rinse out the sink with copious quantities of water. Gloves used while plating from cyanide solutions should be placed in the sink and thoroughly rinsed by allowing water to run over them. To make sure that all cyanide has been removed, put the rinsed gloves in a pan of diluted vinegar out of doors. This will decompose any small amount of cyanide that may remain. Plating tanks should be thoroughly rinsed with several changes of clean water to remove the cyanide. As a final precaution rinse the cleaned tanks with vinegar, out of doors, where the wind will blow any fumes away from you.

ELECTROPLATING



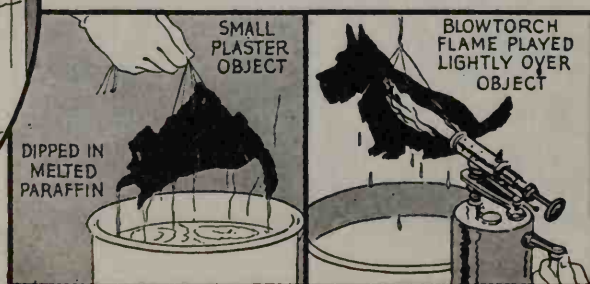
Leather, plastics and other close-grained materials, are washed in alcohol, coated with lacquer, then dusted with graphite or copper powder, after which electroplating is a simple process

ELECTROPLATING of wood, plaster casts, leather, porcelain, pottery, textiles, plastic materials and other non-conductors is a simple matter when the methods explained in this article are used. Flowers, insects, leaves and the like can also be metallized. Objects of the latter type, when plated with gold, silver or another suitable metal, are easily fashioned into novelties and pieces of jewelry of rare natural design.

Preparing Objects for Electroplating: Materials that are porous and therefore would absorb electroplating solution, must be sealed before their surfaces will conduct electricity, which is necessary for electroplating. For open-grained or po-

rous materials, the cleaned object is first treated with melted paraffin, heated to 250° F., preferably by complete immersion, until all trace of bubbles from the pores has ceased. Large objects, which cannot be completely immersed, are painted with the melted paraffin and if possible the object should be heated to 250° F. In either case excess paraffin should be removed after sealing has been completed. Sometimes this can be done by playing a blowtorch flame lightly over the object, starting at the top and gradually working down. The flame must be kept moving. While the object is still hot, surplus paraffin is wiped off with a piece of lintless cloth. This is particularly important when the work contains fine lines which might be obliterated by a film of paraffin. When the blowtorch method is not advisable, excess paraffin must be scraped off very carefully.

Graphiting the Waxed Surface: The surface is next brushed with graphite of the variety used by electrotypers. After covering the surface the surplus



NON-CONDUCTORS



Leaves, flowers, insects and similar delicate articles, are first dipped in diluted silver lacquer, then in silver-nitrate solution, followed by exposure to hydrogen-sulphide gas, to produce conducting surface for electroplating

graphite is wiped off, the work is either immersed for a few seconds in, or brushed with, a well-stirred solution made by adding the same grade of graphite, 2 lbs., to water, 1 gal., and the work is washed in running water to remove the excess graphite. The graphite-solution treatment greatly aids plating and has been found to give far better results than the dry-dusting method alone.

A good grade of fine, copper bronze powder may be used in place of the graphite. It should be shaken up with lacquer thinner and allowed to settle and dry, after pouring off the solvent in order to remove the grease, which invariably coats each particle of the metal powder. If this is overlooked, bronze powders will not give results as good as graphite. With clean bronze powder, plating will be speeded greatly because metal powder is a far better conductor of electricity than graphite. If either the graphite solution or a bronze solution is kept on hand for use as needed,

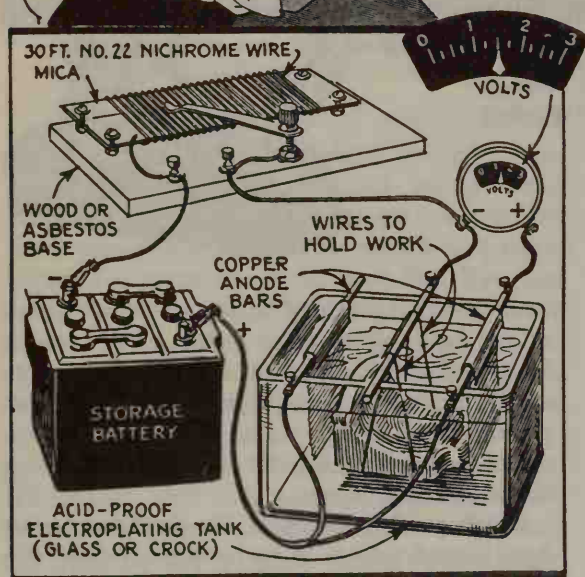
water must be added to replace that which is lost by evaporation. After a few weeks of use, the solutions should be allowed to settle, and the water poured off and replaced with fresh water in order to remove impurities which will collect during the dipping process.

Plating with Copper: Regardless of the final metal which is to be plated onto the job, it must first be copperplated. Any other metal may then be plated over the





Copperplating solution is made by mixing copper sulphate in water and then adding sulphuric acid



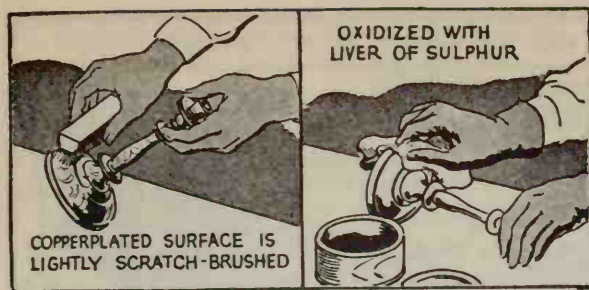
After covering an article with graphite or copper bronze powder, it is immersed in the copperplating bath, connected as shown in the above diagram

copper. It is very important to avoid touching the work with the bare hands, or getting it even slightly dirty or oily, before or during the process of plating. The job is wired up, that is, connected to pieces of clean copper wire for the dual purpose of suspending the job in the plating tank and to conduct electricity to the prepared surface. If possible, a small piece of brass, to which a long wire is soldered, is clamped to the work so that it makes good electrical contact. The brass piece may be adjusted from place to place during the plating operation so the plate will form all over the work. A better method is to suspend the work in a sling of fine copper

wires, in which it can be shifted about easily to eliminate marks that would be left if the wires were kept in the same location. Three copper rods are laid across a glass plating tank. The center rod, connected to the negative terminal of the battery, is used to suspend the work in the solution. Large sheets of copper are suspended from the outside rods. For copperplating, the solution is made by dissolving copper sulphate, 27 oz., in water, 1 gal. To this is added cautiously, while stirring, concentrated sulphuric acid, 6½ oz. All connections are made before the work is suspended in the solution. If the work is suspended in the solution while the current is off, the results may be unsatisfactory. The rheostat is adjusted so that the voltmeter reads 5 volts. This adjustment is maintained for about 5 min., after which the rheostat is again adjusted until the meter reads about 1½ volts.

The work should be inspected from time to time. Too high a voltage will cause the plate to be dark in color, while too low a voltage will not only slow down the work but make the plate crystalline rather than smooth. The ideal voltage to use is the highest value which will give a bright, reddish plate. When lifting the work from the tank, do not turn the current off. The copper plate will not appear all over the job at the same time, but will start at one or more spots and spread until eventually the entire surface is plated. Changing the position of the work in the sling will speed coverage. From 30 to 90 min. will be required for the plate to cover the entire surface if graphite is used as the conducting material. If copper bronze powder is used, the time will be reduced to somewhere between 10 and 30 minutes.

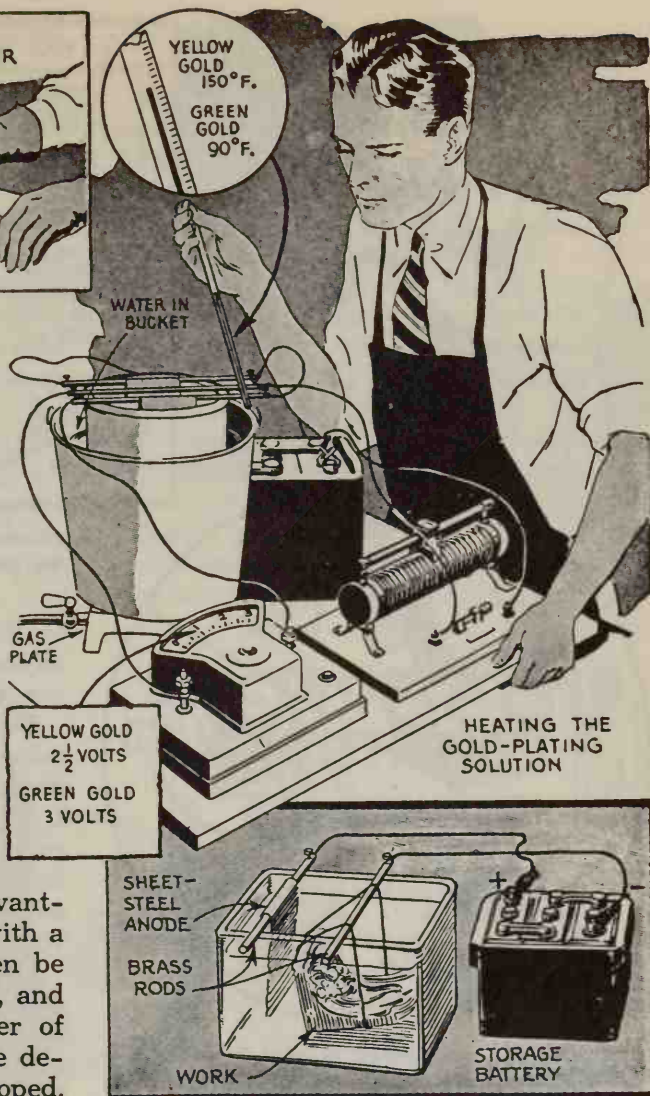
Jobs which are particularly difficult to plate may be speeded by giving them the



so-called oxidizing treatment before immersing them in the plating bath. In this process the graphited surface is wetted with a dilute copperplating solution made by adding an equal volume of water to a small portion of the copperplating solution above described. Fine, clean, grease-free iron filings are then sprinkled over the wet surface and gently brushed until the entire surface is completely covered with red copper plate.

Oxidized Copper Finish: After plating with copper, the work should be lightly touched with a soft-wire scratch brush. This must be done cautiously as the plate is thin. If an oxidized-copper finish is wanted, the work is next lightly buffed with a cloth buff and rouge. It should then be cleaned in a hot lye solution, rinsed, and brushed with a hot solution of liver of sulphur and distilled water, until the desired tone of brown has been developed. The work is finally washed, dried, and lightly scratch-brushed to bring out high lights, and given a final coat of clear metal lacquer to preserve the finish.

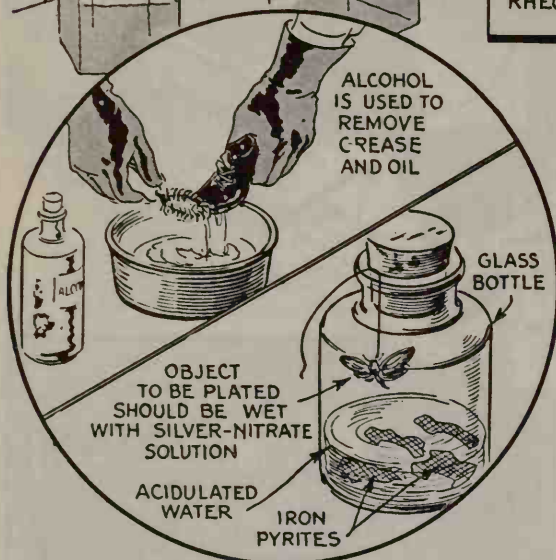
Silver-Plating: If silver or any other metal is to be plated over the copper, the work is thoroughly washed after removal from the copperplating solution and left suspended under clean water until the other plating solution is ready for use. If the copper plate is left exposed to the air it will become slightly corroded and this will make it difficult to plate with another metal. The silver-cyanide plating solution described here is particularly effective for this kind of work. Three solutions are required. The first or blue-dip solution is made by dissolving sodium cyanide, 6 oz., and bichloride of mercury, $\frac{1}{2}$ oz., in water, 1 gal. The work is transferred to this solution for a second to coat the surface with



Above, while gold-plating, the solutions are kept at uniform temperatures in a water bath; below, after work to be silver-plated is "blue-dipped," it is placed in this silver "strike" solution

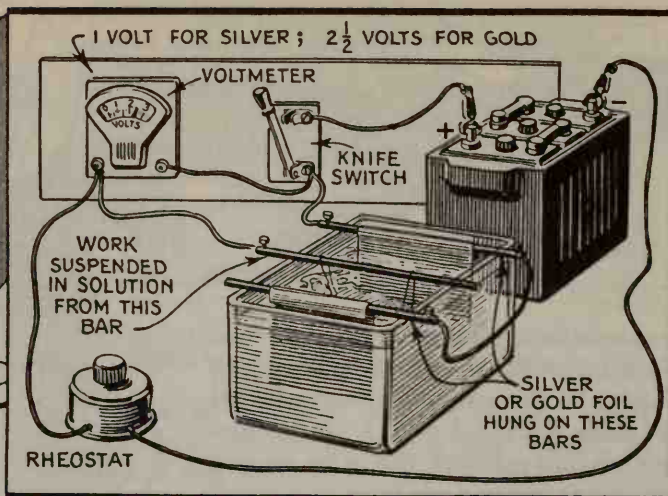
mercury and then it is immediately suspended in the second or so-called "strike" solution made by dissolving sodium cyanide, 8 oz. (96 to 98% pure), silver cyanide, $\frac{1}{2}$ oz., and caustic soda, $\frac{1}{4}$ oz., in water, 1 gal.

This solution as well as others containing cyanides are extremely poisonous and must be handled with great care. They should be used in a well ventilated room and near an open window. Under no conditions must acid or copper-sulphate plating solution be spilled into cyanide solutions, as this would cause their decomposition and the generation of deadly poisonous hydrocyanic-acid fumes. When working with cyanide solutions, wear rub-



Leather articles are washed in alcohol before proceeding; below, insects and delicate objects being exposed to hydrogen sulphide before electroplating

ber gloves to protect your self against entrance of the poison through cuts or skin abrasions. These solutions are used daily without mishap, and if the rules given here are followed, they are perfectly safe. The strike solution is used in a clean plating tank and connected as shown in one of the drawings. Sheets of steel are suspended from the positive rods. The job is wired to the center or negative rod and immersed in the solution with the current on without a rheostat. In a few seconds a silver coating will completely cover it. It is then removed and immediately transferred to the silver-plating solution made by dissolving sodium cyanide (96-98% pure), 4½ oz., silver cyanide, 3 oz., and ammonium chloride, ⅛ oz., in water, 1 gal. If a bright plate is wanted, carbon bisulphide, 1 oz. (inflammable), may be added



Arrangement for gold and silver-plating; of course, the plating solutions, anodes and voltage requirements are different

to the solution. The rheostat should be adjusted carefully until the voltmeter reads about 1 volt.

Gold-Plating: Yellow gold plate is produced over copper with a solution made by dissolving sodium cyanide (96-98% pure), 1 oz., potassium gold cyanide, ½ oz., and caustic potash, ⅛ oz., in water, 1 gal. Gold foil is used for anodes and the rheostat is adjusted until the voltmeter reads 2½ volts.

This solution will work best if kept heated to a temperature of 150° F. Green gold plate is produced with a solution made by dissolving sodium cyanide (96-98% pure), 1½ oz., caustic potash, ¼ oz., and green gold cyanide, 1 oz., in water, 1 gal. It is used as explained for yellow gold except, that the temperature should be 90° F. and the voltage should be adjusted to 3 volts.

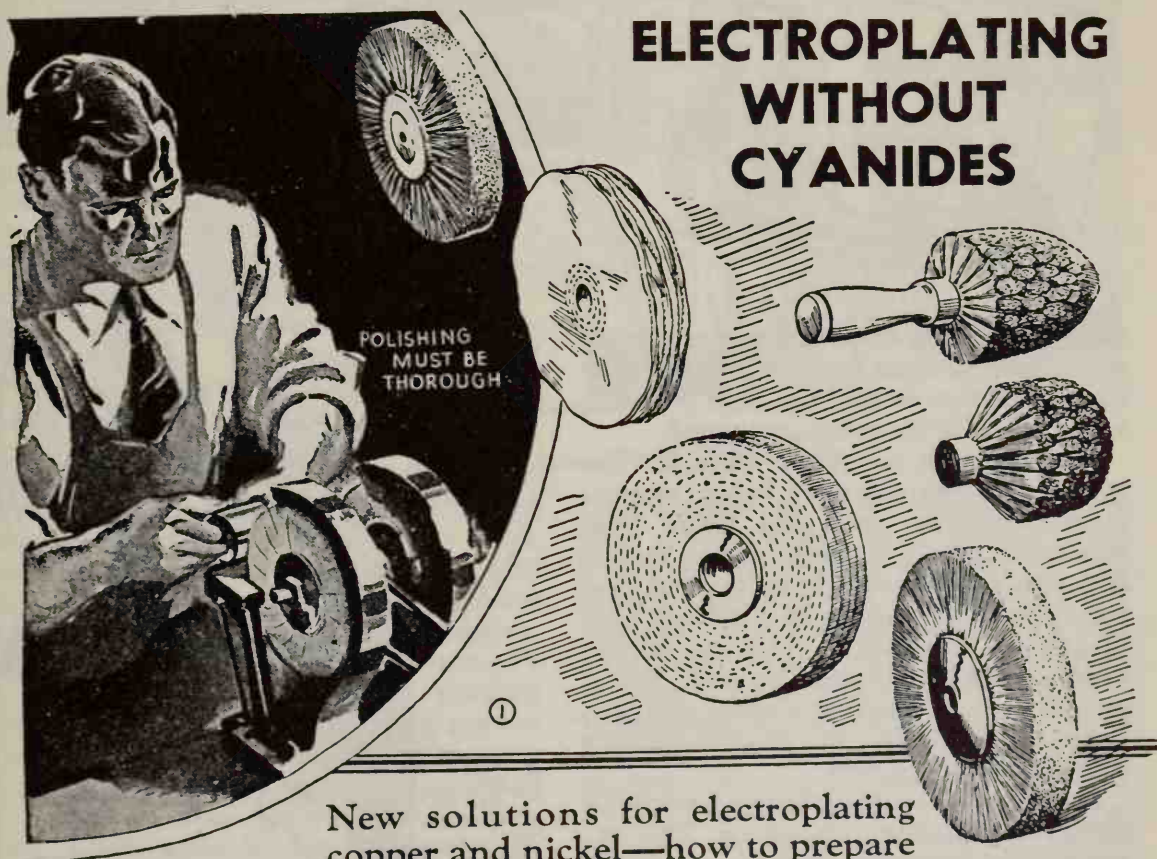
Other metals such as nickel and chromium may be plated over the copper by using standard plating solutions.

Plating Leather, Textiles and Plastics: Leather, textiles, plastics, as well as close-grained materials which do not absorb moisture readily, can be sealed with a good grade of spar varnish or with water-resistant clear lacquer. Rigid articles, after being thoroughly washed with alcohol to remove all traces of grease, are dipped into, or painted with, varnish or lacquer. Fragile items should be sprayed with varnish or lacquer thinned with alcohol. After thoroughly drying, a second coat of commercial electrotypers' varnish

is applied uniformly. When the varnish has dried tacky, finely ground graphite is dusted on every part to be plated. Copper powder may be used in place of graphite. After this treatment, you can proceed with plating as already described.

Leaves, Flowers and Insects: Leaves, flowers, insects and other delicate objects whose markings must be preserved in the final plate with more accuracy than is possible with the graphite or metal-powder methods should be chemically treated to render them conducting. This is done by first dipping the object in a dilute solution of silver lacquer and allowing the thin film to dry thoroughly. When dry, the job is next dipped into a solution made by dissolving silver nitrate, $\frac{1}{2}$ oz., in water, 1 pint. The object should be left in this

solution until its surface is thoroughly wetted. The wet job is then suspended in a bottle in the bottom of which there should be a few lumps of iron pyrites. These should be covered with water, to which is added a few drops of hydrochloric acid just before the object is suspended inside the bottle, but above the water. Hydrogen sulphide will be generated in the bottle and this reacts chemically with silver nitrate to form silver sulphide, an insoluble substance which is a fairly good conductor of electricity. When the coating of sulphide is complete, the object may be copperplated and then finished with any other desired plate. When using the sulphide process it is well to work outdoors as the gas is evil smelling and is somewhat poisonous if too much is inhaled.



ELECTROPLATING WITHOUT CYANIDES

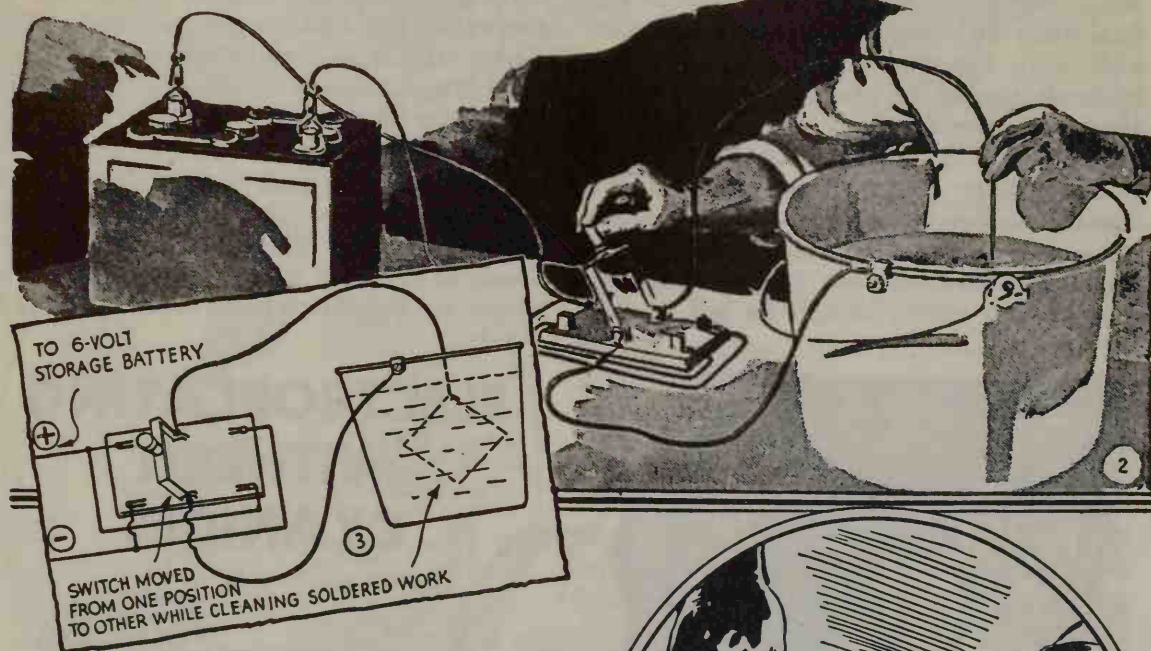
New solutions for electroplating copper and nickel—how to prepare work by thorough cleaning procedure, both chemical and electrical

ELECTROPLATING solutions can be made now without the use of poisonous cyanides. By the improved methods, it is also possible to plate zinc castings and zinc-base die castings which have proved so troublesome by other methods.

Polishing the Work: Before electroplating, it is important that the object be buffed and polished carefully to remove all surface imperfections. Flaws in the surface of the work to be plated will show noticeably after the plating and therefore,

these must be removed first if a first-class job is to be produced. A buffing wheel treated with any good quality cutting compound is used for this purpose. Simple buffing heads may be equipped with a variety of interchangeable wheels, Fig. 1, for the application of cutting and buffing compounds as required to produce the

The work is suspended in the cleaning solution for 1 or 2 min.—no longer than necessary to remove the dirt film. Bubbling from the surface of the work mechanically tears the dirt away. While electro-cleaning soldered work, the current is reversed by means of a switch as shown in Figs. 2 and 3.



final finish. It is advisable to use a separate wheel for each grade of compound to avoid scratches during the final polishing operation with finishing compound.

Cleaning Iron and Steel Objects: The type of cleaning operation before electroplating depends upon the metal from which the object is made. After buffing thoroughly, objects made of iron and steel are cleaned by washing in a solvent such as gasoline (not Ethyl), benzene, carbon tetrachloride or xylene. The wash, Fig. 4, removes grease from the surface and prepares the work for the electro-cleaning operation which is next.

An electro-cleaning solution is made by dissolving trisodium phosphate, 13½ oz., and sodium carbonate, 10¾ oz., in enough water to make 1 gal. of cleaning solution. The solution should be placed in an iron pail large enough to hold the work without its coming in contact with the container, Fig. 5. For electro-cleaning steel and iron, the pail is connected to the negative pole of a 6-volt storage battery with heavy copper wire, while the work is connected to the positive pole of the battery.



Following the electro-cleaning operation, the work should be rinsed thoroughly in running water as in Fig. 6. Then it is immersed for 1 or 2 min. in a solution made by adding concentrated hydrochloric acid, 1 lb., to water, 7 pts. The acid rinse, Fig. 7, performs the very important function of putting the metal surface into a condition so that electroplate will stick to it. Stoneware vessels are used for all acid solutions. Following the acid treatment,



the work is rinsed thoroughly in running water and kept submerged in clean water until it is put in the plating tank.

Cleaning Zinc Objects: Objects made of zinc should be cleaned with solvents as explained for iron to remove excess grease. Following this, the work is scrubbed with soapy water to remove the last trace of foreign matter. Then the work is dipped into a solution made by adding concentrated hydrochloric acid, 1 lb., to water, 1 pt. The work should be dipped merely into this solution and not allowed to remain there, or it will become pitted. After the acid dip, the work is rinsed in running water and submerged in clean water until plating.

Cleaning Zinc-Base Die Castings: To plate zinc-base die castings the cleaning operations must be followed with greater than normal care. The well buffed castings are freed from grease by washing in a solvent such as trichlorethylene, benzene, carbon tetrachloride or xylene. The latter will be found the most satisfactory. Then the work is suspended in an electro-cleaning bath made by dissolving trisodium phosphate, 6 oz., in water, 1 gal. This solution is heated and used at the boiling point. It is important to note that the connections shown in Fig. 5 are just the opposite to the connections for elec-

tro-cleaning iron and steel, as already explained. The work should be suspended in the electro-cleaner for only 3 min. at the most, although 2 to 2½ min. is usually sufficient. An immersion longer than 3 min. is likely to cause pitting. Following the electro-cleaning operation, the work is rinsed rapidly in running water and immersed for only 1 min. in a solution made by mixing hydrochloric acid, 1 lb., with water, 4 pts. Following the acid treatment, the work is washed in running water and submerged in clean water until plating.

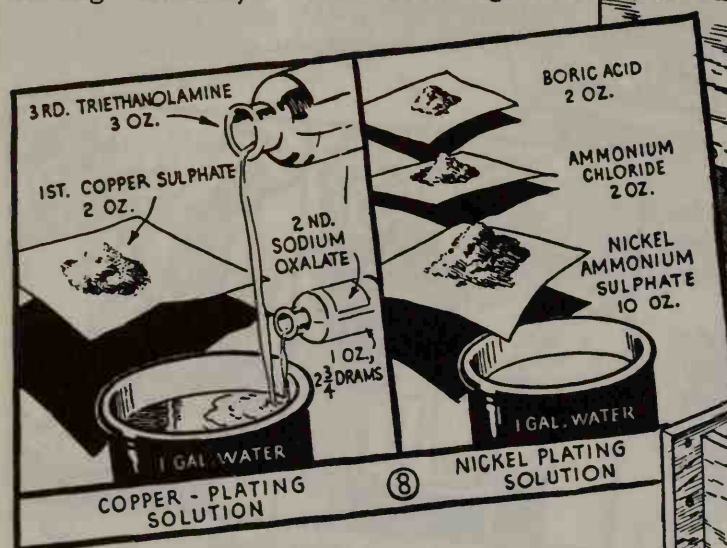
Cleaning Copper and Brass: After buffing and polishing, objects made of copper or brass should be cleaned thoroughly in any of the solvents already mentioned to remove excess grease. An electro-cleaning



bath arranged as shown in Fig. 5 is next. The wires are connected directly to a 6-volt storage battery, the negative line being connected to the work, which is left immersed in this solution from 3 to 5 min.—no longer to avoid pitting. A cleaning solution which has been found exceedingly satisfactory for use with these metals is made by dissolving sodium carbonate, 8 oz., and sodium hydroxide or ordinary lye, 2 oz., in enough water to make 1 gal. of solution. In electro-cleaning objects of copper, brass, and other metals that have been soldered, connections are made to a double-pole, double-throw switch as in Fig. 3, to permit reversing the polarity, as the action of the electro-cleaning solution, without reversing the polarity every few seconds, tends to dissolve part of the solder.

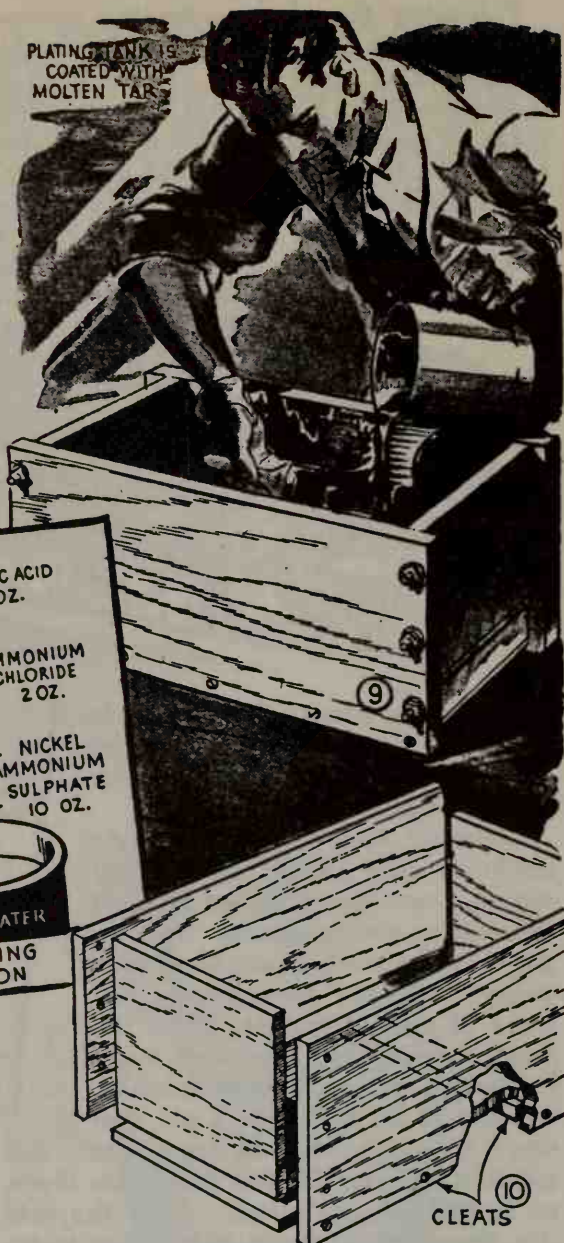
Copperplating: A non-poisonous solu-

tion for plating copper or iron or other metal is made by dissolving copper sulphate, 2 oz., and sodium oxalate, 1 oz., $2\frac{3}{4}$ drams, in enough water to make 1 gal. of solution. Finally, triethanolamine, 3 fl. oz., is added to this solution and stirred in. See Fig. 8. The solution should be prepared in a stoneware container, preferably the one which is to be used for plating. The solution should be stirred until the precipitate which at first forms is dissolved. After using this solution, a slight sediment may be found but this does not interfere with plating. Connections for plating in a stoneware or other non-conducting container, are made as in Figs. 11

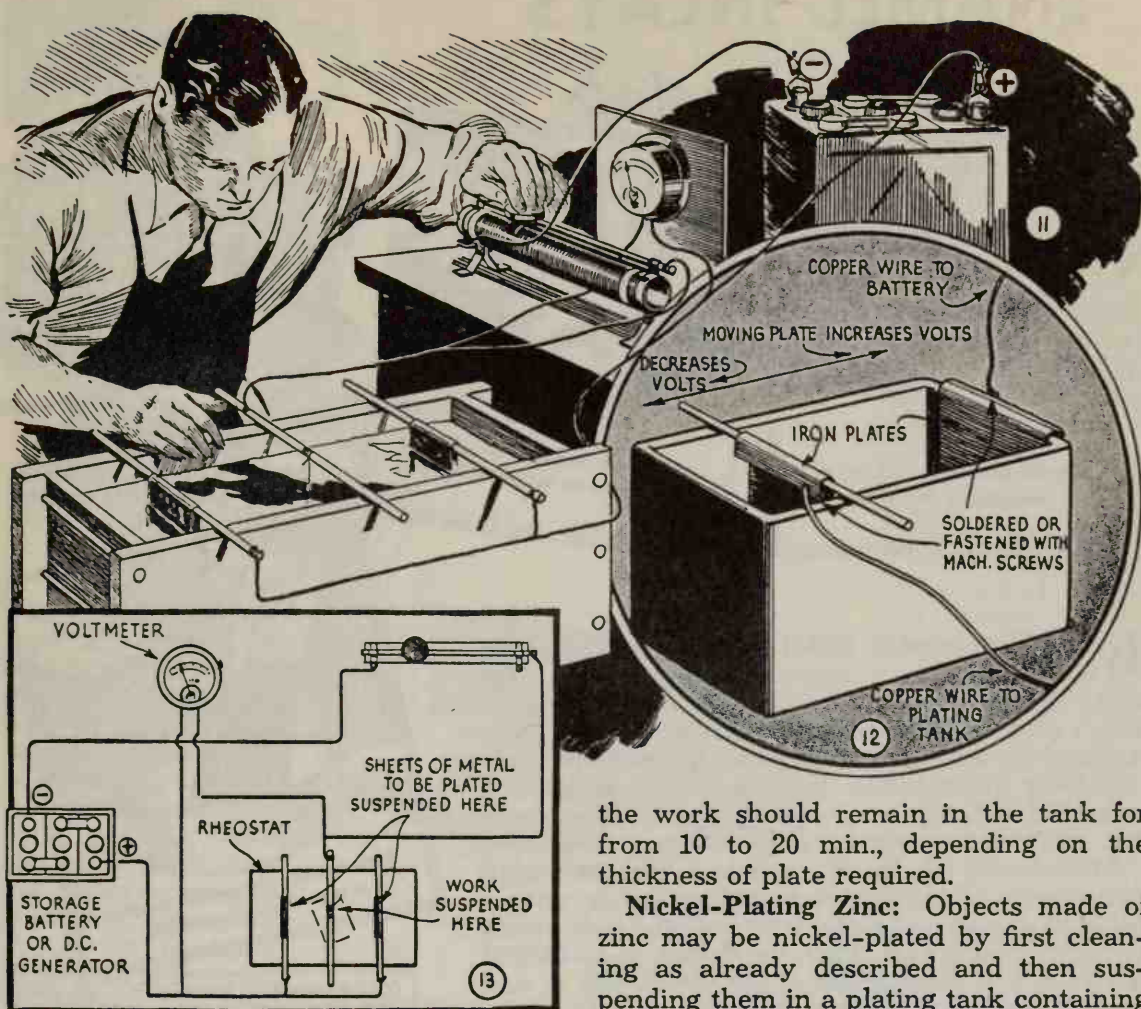


and 13. An old rubber battery box is suitable, or you can make a wooden tank as shown in Figs. 9 and 10. Almost any rheostat will do. If one is not available a substitute may be made as in Fig. 12. It is filled with a solution made by dissolving as much ordinary salt as possible in cold water. A pair of metal plates are inserted into the salt solution. The closer the plates are together, the higher the voltage.

To use the copperplating solution, the work is hung with a copper wire on the middle rod and immersed in the plating solution. Large sheets of copper are attached to the rods which are connected to the positive pole of the battery. With the work immersed, the switch is closed and the rheostat adjusted until the voltmeter reads between $1\frac{1}{2}$ and $2\frac{1}{2}$ volts. The exact voltage will have to be determined by experiment in any particular case to control the brilliancy of the plate, the work



being lifted from the bath frequently to note the color of the deposit. The rheostat is adjusted until a suitable bright deposit is produced. The work should be left in the plating bath for 3 min. to produce a good durable plate. Where it is necessary to build up a heavy plate of copper, the work, which has been plated for 3 min., is transferred to another plating solution made by dissolving copper sulphate, 22 oz., in water, 1 gal., to which sulphuric acid, $6\frac{1}{2}$ fl. oz., is added slowly. Before transferring the work to this solution, it should be rinsed thoroughly in water to remove all traces of the alkaline triethanolamine. It is then immersed in



the acid copper-sulphate solution and connected in the same way as in the first plating bath. The rheostat is adjusted until the meter reads between $1\frac{1}{2}$ and 3 volts as required to produce the proper color.

Nickel-Plating Iron: The nickel-plating of iron objects offers material protection against corrosion and the plate will be quite durable if it is applied after the work has been given a 3-min. plate of copper. For plating nickel over copper, a solution made by dissolving nickel ammonium sulphate, 10 oz., ammonium chloride, 2 oz., and boric acid, 2 oz., in water, 1 gal., will give satisfactory results. See Fig. 8. The solution is poured in a clean plating tank connected as before. Strips of sheet metal are suspended from the outside rods across the plating tank. If the nickel plate is to be used for protective purposes as well as for ornamentation, it should be rather thick. The meter should read between 2 and 3 volts, and

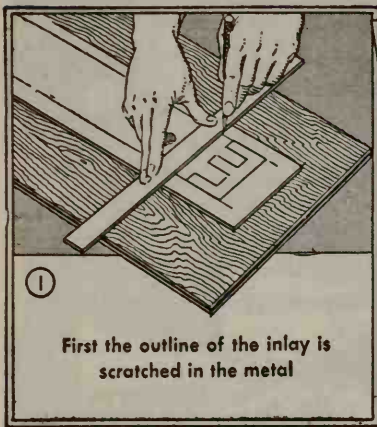
the work should remain in the tank for from 10 to 20 min., depending on the thickness of plate required.

Nickel-Plating Zinc: Objects made of zinc may be nickel-plated by first cleaning as already described and then suspending them in a plating tank containing a solution made by dissolving nickel ammonium sulphate, 11 oz., and nickel sulphate, $5\frac{1}{2}$ oz., in water enough to make 1 gal. When the chemicals have been dissolved in the water, triethanolamine, 23 fl. oz., is added and mixed in thoroughly. The work is hung from the center rod and sheets of nickel from the two outside rods. The voltage should be adjusted to between $1\frac{1}{2}$ and 3 volts. If the nickel-plate is not sufficiently brilliant, a small amount of boric acid may be stirred into the solution.

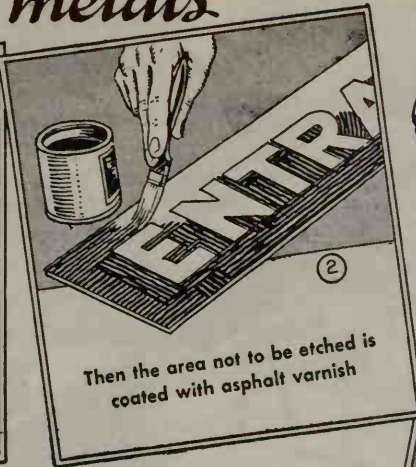
Nickel-Plating Zinc-Base Die Castings: Zinc-base die castings cleaned as explained are suspended in a plating tank and connected as in Fig. 13. The plating solution is made by dissolving nickel ammonium sulphate, $3\frac{1}{4}$ oz., and nickel chloride, $1\frac{1}{2}$ oz., in water, 1 gal. After the salts are dissolved, triethanolamine, $8\frac{3}{4}$ fl. oz., should be added and stirred in thoroughly. The voltage should read between $1\frac{1}{2}$ and 3. Boric acid, about $\frac{1}{2}$ oz., can be added to this solution to brighten the plate.

ENAMEL INLAYS

baked on metals



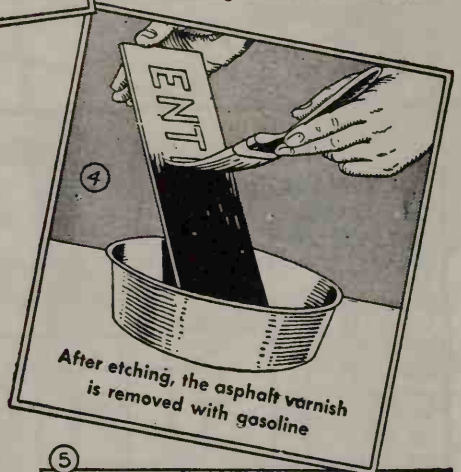
First the outline of the inlay is scratched in the metal



Then the area not to be etched is coated with asphalt varnish



The plate is allowed to remain in an etching bath 5 to 15 minutes



After etching, the asphalt varnish is removed with gasoline

⑤

COLOR PIGMENTS SUITABLE FOR USE WITH VINYL ENAMELS	
Color	Pigment
Blue . .	"Monastral" fast blue B
Green . .	"Monastral" fast green G
Yellow . .	"Lithosol" yellow G conc.
Orange . .	"Lithosol" fast orange G powder.
Red . .	"Lithosol" red 2BD powder



PLACE DRY COLOR IN MORTAR

ADD PART OF VINYL LACQUER

GRIND TILL SMOOTH. ADD REST OF LACQUER.

PREPARING COLORED ENAMELS FOR BAKING

BAKING enamel on metal to form a hard, glistening decoration is interesting work and offers many possibilities to establish a profitable business. Name plates, ash trays and other novelties are only a few of the articles that anyone can turn out inexpensively in quantities. The enamel can be applied as an inlaid design, or it can be applied as an overlay, and you can even cover the entire article.

For inlaid work, the first step is to etch the design in the metal. This is first cleaned thoroughly, using a solution of soap and water with washing soda added to remove all grease. Then the design to be etched is laid out on the surface of the metal, Fig. 1, and asphalt varnish is painted carefully over all of the surfaces of the work not to be etched, Fig. 2. Any varnish that gets on the surfaces that are to be etched can be removed by carefully scraping it away, or by the use of a cloth soaked in gasoline or naphtha. Small work can be entirely immersed in the solution, but if the article is large, or if only a part is to be etched, a dam can be built around the etched part with paraffin or other wax and coated on the inside with asphalt varnish to form a pool to contain the etching solution. This must be handled in glass or earthenware containers, and rubber gloves should be worn to protect the hands, Fig. 3.

Etching solutions: On brass and copper, a solution of nitric acid, 1 fl. oz., in water, 8 fl. oz., will give a rapid etch. On iron and steel, it is best to use a mixture of nitric acid, 2 parts, and glacial acetic acid, 1 part, or a solution of hydrochloric acid, 1 fl. oz., and potassium chlorate, $\frac{1}{2}$ oz., in water, 8 fl. oz. On aluminum, use strong hydrochloric acid. Other etching agents as commonly used can be substituted if desired. The etching will be more rapid if the work is

heated, but it should not be heated enough to soften the asphalt varnish. The etch should be deep enough to take about three coats of enamel. Generally, about 5 to 15 min. will be sufficient. If etching is more rapid than desired, reduce the temperature of the work if it has been heated, or dilute the solution with water.

Preparing for enameling: After the etching has been completed, remove the work and wash away the etching solution with

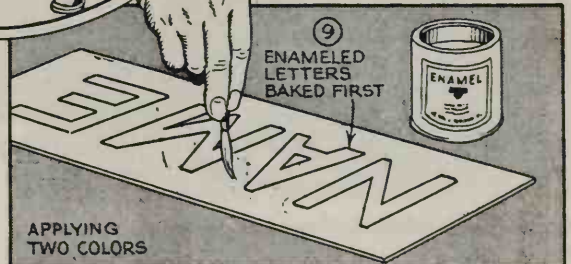


water. When dry, remove the coating of asphalt varnish by soaking in gasoline or with a brush or cloth soaked in gasoline or naphtha, Fig. 4. Lead-free gasoline must be used, and the work should be done in a ventilated room away from fire. The work should be cleaned with soap and water to remove any remaining grease or dirt. After drying, it is ready for enameling. Ready-prepared transparent and opaque colors as well as complete enameling kits are available for the beginner. However, if you are doing this work regularly, the best way to get enamels is to buy the colors in bulk and grind your own as needed. To prepare a colored enamel, place the powdered color in the mortar and add a part of the clear lacquer required. Grind this well, Fig. 6, to remove all lumps and leave a smooth mix. Now add additional clear lacquer to the mix until the color reaches the desired shade.

Applying the enamel: As many metals cause deterioration of the vinyl film, it is advisable to apply a coat of vinyl primer. The primer, which is not required on aluminum, is carefully brushed or sprayed over the areas that are to receive the enamel, Fig. 7, and is allowed to dry until no longer tacky. Then the work is put into an oven, Fig. 8, and baked at 280 or 300 deg. F. for approximately an hour. The time required is longer on heavier articles. A sheet-metal oven that can be purchased at any hardware store is used. An oven-

type thermometer should be used and the temperature controlled carefully to prevent overheating, which may damage the primer film. Do not place the work on the bottom of the oven, which is generally right above the flame and where the work will almost certainly overheat. After baking and cooling, the primer should be hard and should adhere very tightly to the metal. If it does not, the baking time should be increased without raising the temperature above 300 deg. F.

After the priming coat has been baked on the work, the colored enamels are applied in the same manner. The enamel should not be applied in too thick a coat as blistering may occur. If, after drying and baking, the surface of the enameled area is below the surface of the metal, a second coat should be applied and baked on. Ordinarily, at least two coats will be required. Two or more colors can be used to give additional decoration. If two colored areas touch with no metal between them, one should be



applied and baked on before applying the other, Fig. 9.

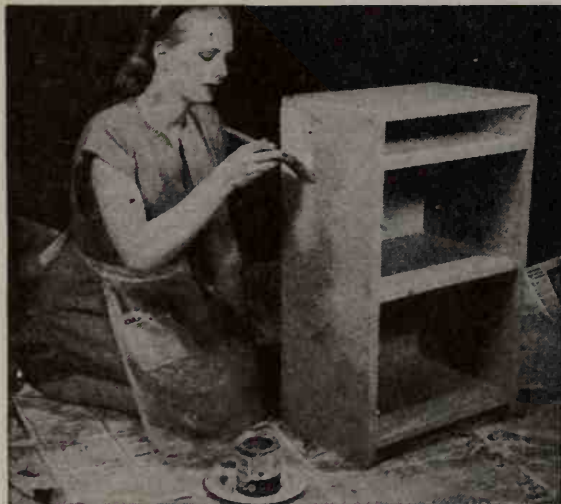
Finishing the work: Articles finished as described are extremely attractive and no further work is really required. However, for best results, the entire surface should be stoned with Carborundum enamel files. Good polishing can then be done on a sheet of plate glass with lime or rouge abrasives mixed with water to form a thin paste. Polishing can also be done with a hard-felt wheel revolving in the lathe, using lime, rouge or fine pumice abrasives. If stoning and polishing are planned in advance, the piece should be overcharged, and the enamel then made level with the metal by stoning (filing). Polishing will cut the metal as well as the enamel and will remove small scratches caused by filing with fine (180-grit) Carborundum sticks.



1 Sand bare wood with 3/0 sandpaper. Remove hardware or mask with masking tape



2 Apply white undercoater, brushing out well. Sand work when dry, using 6/0 sandpaper



3 Flow the enamel on across the wood grain and then tip it off lightly with the grain

Du Pont photos



ENAMEL *for*

WHETHER it's new wood or a refinish job over old paint, there's no denying that a coat of colorful enamel makes a lot of difference on toys, woodwork and furniture. The new resins are tough, heat and water-proof—they flow out like magic under the brush to a chinalike finish. One coat will cover most surfaces, although new wood will have a much richer appearance if given two coats of enamel or one coat of undercoat and one coat of enamel.

Surface preparation: New wood should be sanded smooth with 2/0 to 4/0 garnet or aluminum oxide abrasive paper, using a felt or wood block for backing. Cracks and nail holes should be filled, using wood dough, patching plaster, putty, or a mixture of Weldwood glue powder mixed half and half with fine sanding sawdust before adding water. This kind of patching can be done on bare wood. Waxy or dirty refinish work should be washed with a detergent household cleaner; if the work is reasonably clean, a wipe with turpentine, alcohol or any of the special preparations made for cleaning and conditioning old paint can be used. Always, in any kind of finishing, keep in mind that paint will not stick over dirt, and, paint is never any smoother than the surface to which it is applied.

Application: Use a 1½ or 2-in. brush, new or thoroughly clean. Stir the enamel from the bottom. Don't shake the can because this usually causes a lot of bubbles. Two-way brushing is best for a smooth, even paint film—lay the paint on across the wood grain and then brush lightly with the grain. Cover an area 6 to 10 in. square in this manner, then another area, and so on. Always have a good light so placed as to glare on the fresh paint—it will help you to avoid skipped places, runs and coarse brushing. If you get a runner on fresh paint, brush it out with a nearly dry brush; if you find a runner on partly set paint, brush it out with a loaded brush. Paint chairs and tables upside down, doing the underbody and legs first, then stand erect. Do chair seats and table tops last.

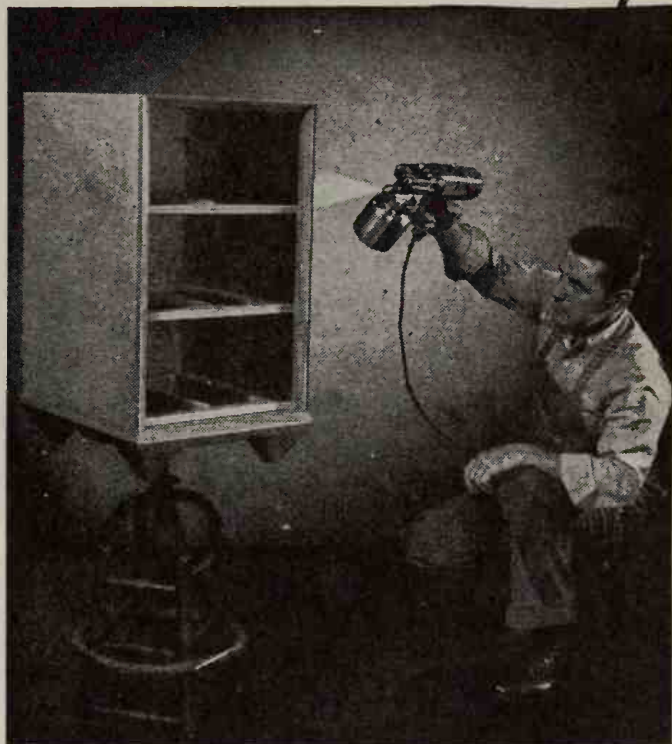
Schedules: Complete step-by-step operations for enameling are given in the furniture schedules.



Colorful BEAUTY

Generally, one coat will do for most refinish work. A two-coat system can be either one coat of enamel undercoat or two enamel coats. If you use two coats of enamel, it is usually best to thin the first coat with about 10 percent turpentine. The enamel undercoater comes in white only, this color being satisfactory under all light colors. If you are using a dark enamel and want good coverage in one coat, it is best to tint the undercoater with enamel, using about 3 parts undercoater to 1 part enamel. It is also practical to tint the undercoater with oil colors. Fluid oil colors in cans are best for this work since they mix more readily than the stiff paste of tube colors. The enamel finish will be full gloss. Some products are available in semigloss. The gloss enamel can be made less shiny by adding semigloss of the same color or by adding up to $\frac{1}{3}$ undercoat. If you use undercoat in this way, it is necessary to tint it with fluid oil colors to the approximate color of the enamel, the mixing being done before the undercoater is added to the enamel. Sometimes, of course, the letdown with white undercoater will produce just the color you want.

Pointers: Never leave dead-sharp edges on your wood projects—sand down to a round as big as a pencil lead and you will have edges that look sharp and hold paint. While enamel is usually applied on close-



SPRAY GUN does fast, smooth work and is the ideal tool for painting furniture. Either suction or pressure feed will do

grain wood, don't forget that if you paint open-grain wood you will need paste wood filler to fill the pores. Many finishers like to use a thin filler on softwood end grain to kill the natural suction of the wood. If you are using two or more coats, always scuff sand between coats to remove nibs of dirt. Use 3/0 paper for fine sanding bare wood and 6/0 for sanding the dull paint.

Job Pointers



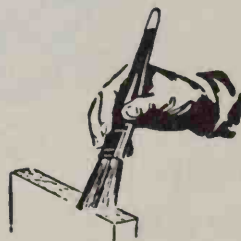
WELDWOOD GLUE AND SAWDUST MAKE A GOOD CRACK FILLER



EDGES WON'T CHIP IF SANDED WITH 2/0 PAPER TO LEAD-PENCIL ROUND



IF ENAMEL IS DARK, TINT UNDERCOAT WITH $\frac{1}{4}$ ENAMEL



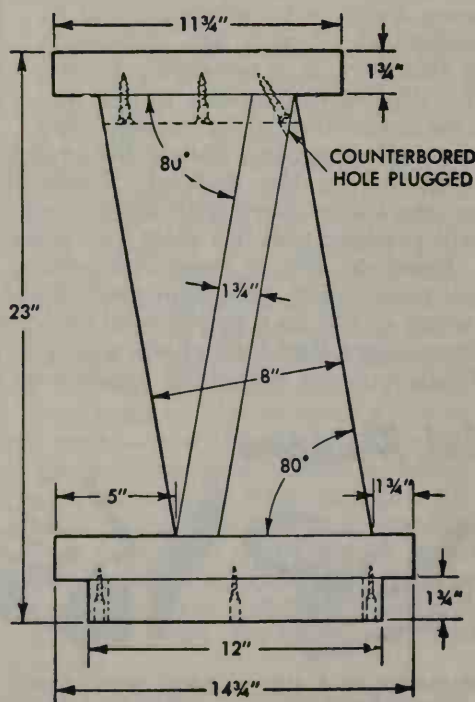
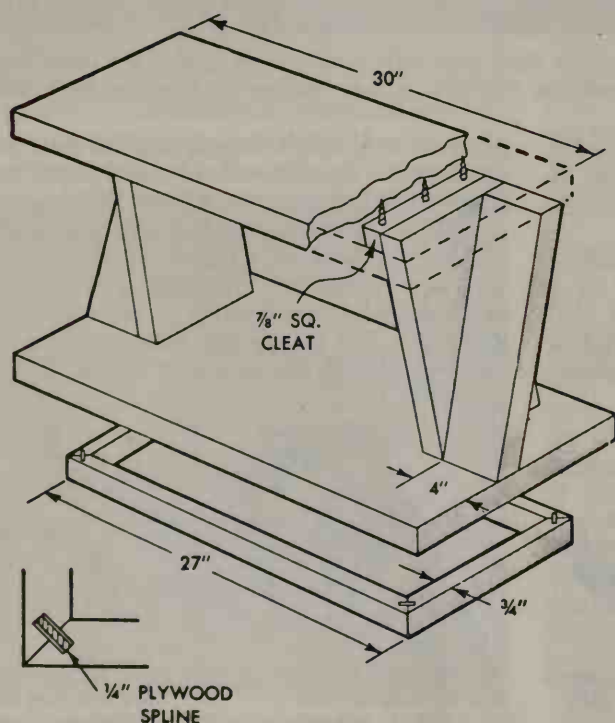
THIN PASTE WOOD FILLER WILL STOP SUCTION ON SOFTWOOD END GRAIN

END TABLE

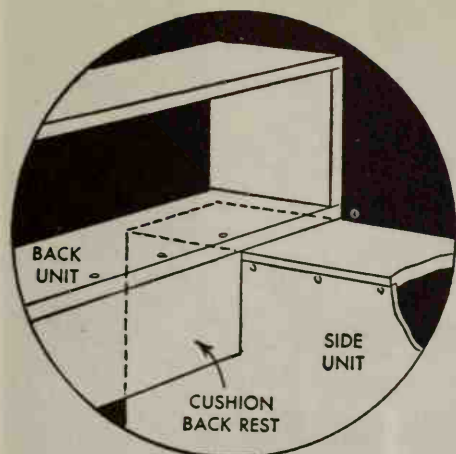
NO POWER TOOLS required—that's the story on this striking modern end table. Assembled from standard widths of 2-in. pine, the table features an offset side as well as a straight side, so that it fits snugly against a sofa or easy chair having either straight, slanted or flared arms. The top of the table is cut to length from a 2 x 12 while the bottom is made from a 2 x 15. If the 15-in. stock is not available, two lengths of narrower stock can be doweled and edge-glued together to attain the desired width. The slanting uprights, the outer ones of 2 x 4 and the inner ones of 2 x 8-in. stock, are all cut at an 80-deg. angle. The uprights are assembled with finishing nails or countersunk screws driven through the inner faces of the 2 x 8s and through the underside of the bottom. The base of the table is made in picture-frame fashion with miter joints at the corners that are reinforced with plywood splines. The table top is mounted on two cleats which are fastened to the uprights. All joints are glued, and visible nail or screw holes are filled with wood putty or plugged.



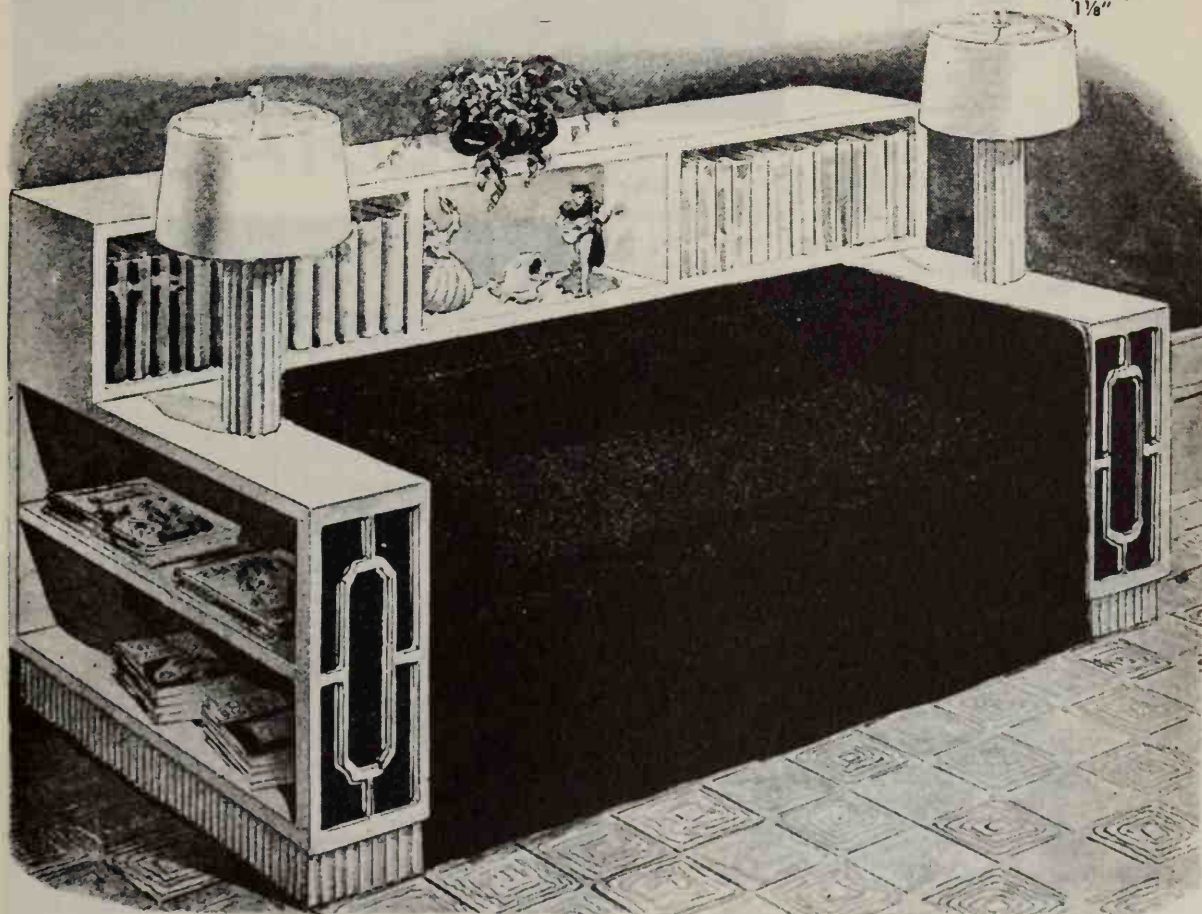
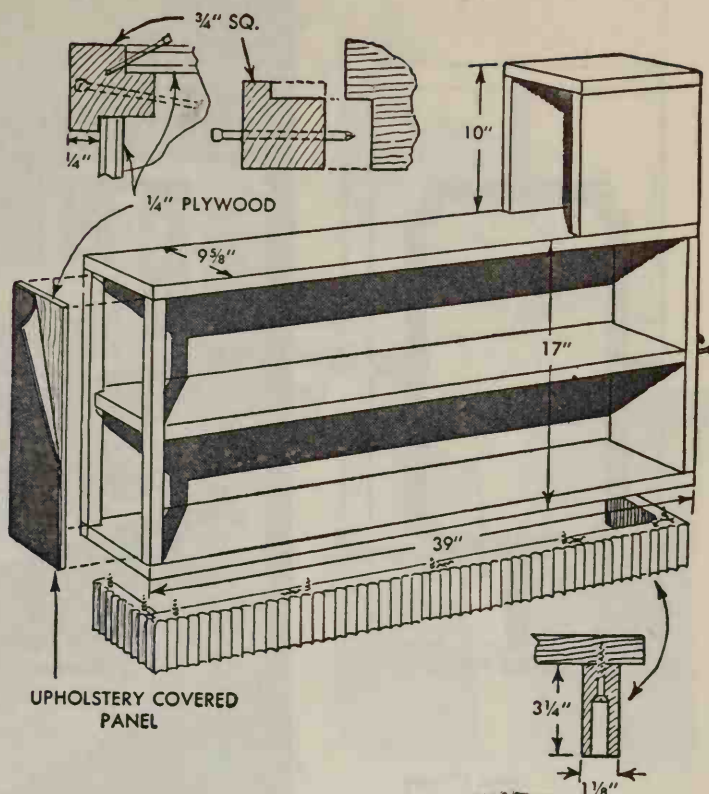
This modern end table fits neatly against either a straight or slanted chair arm. The table is made of pine and finished in the natural color with clear shellac and wax, or it can be lacquered as desired.

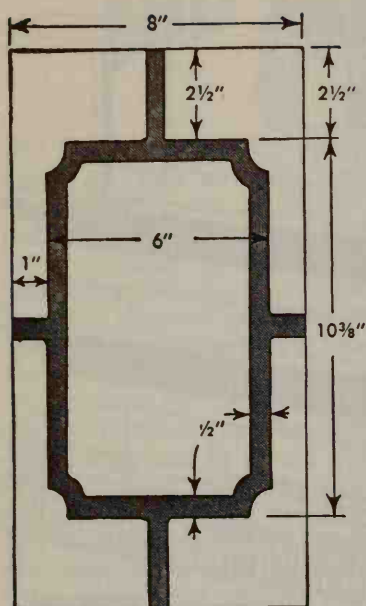


END TABLES

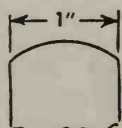


For the connecting bookshelf idea the stepped tops of the end tables are omitted as shown above. The separate book section simply sets in place, making the whole thing easily portable and especially suitable for small apartment use. Although shown open, the back of the top unit can be closed with plywood. Arm and back cushions are tailored to come flush with the tables, and twin lamps matching the fluting on the base can be attached permanently in place

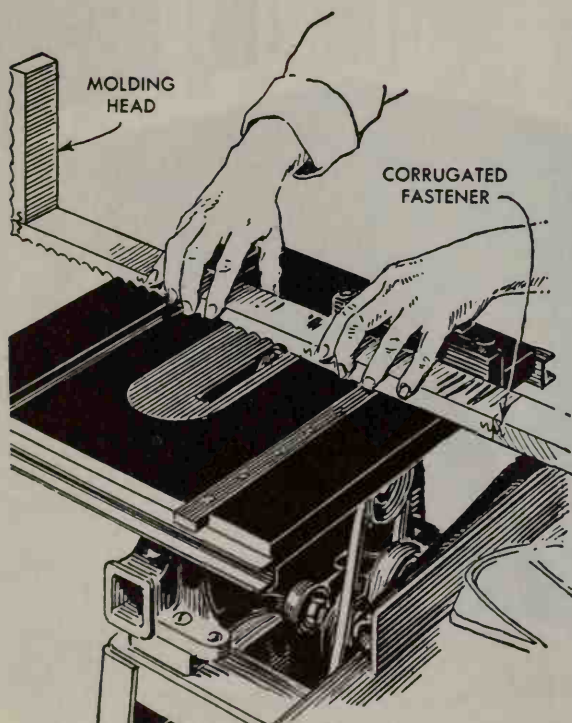




FRETWORK PATTERN



SHAPE OF
CUTTER BLADE



HOW BASE BAND IS FLUTED

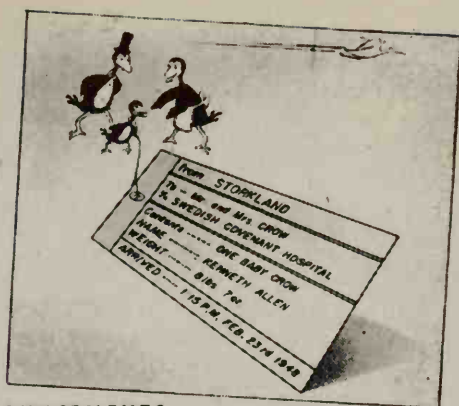
USE them at each end, or join them across the back with a book shelf and see what a lift these unit end tables give that dated studio couch. Pine will do for a painted finish and you can "upholster" the fronts to either match or contrast with the couch covering. The couch at hand will determine the size of the tables. Using common 1 by 10 lumber (actually $\frac{3}{4}$ in. by $9\frac{3}{4}$ in.), you'll only have to cut the pieces to length. Two $\frac{3}{4}$ -in.-square posts form the fretwork opening, these being rabbeted as shown to take plywood panels. The cloth-covered panel must be slipped in place before the top board is fastened and is held with small brads. Then the facing fretwork is fitted flush in the opening. The base is built up of random widths of $1\frac{1}{8}$ -in. stock with the grain running up and down. If you don't have a molding head, the fluting can be done by hand with a 1-in. gouge and then smoothed with a sandpaper block. Screws in counterbored holes are used to attach the base to the table, $\frac{3}{4}$ in. in from the edge.



CHRISTMAS CARDS



2



1

ANNOUNCEMENTS



BOOK MATCHES

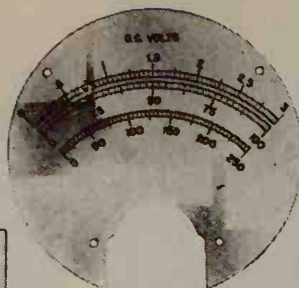
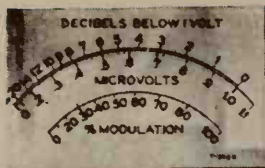
ENLARGER

THERE'S more to be had from an enlarger than just blowups. In many cases, this versatile darkroom accessory can be equipped at little cost to function as an efficient copying camera. All you need are just three items, a camera adapter back to slide between the bellows and lamp house of your enlarger, a pair of copying lamps and a homemade mirror attachment for viewing the ground glass and focusing, Fig. 8. The camera adapter back must be one that is made to fit your particular enlarger and you should buy two cut-film holders to fit it. The enlarger shown in Fig. 4 is a 4 x 5-in. Omega and takes the same type holder as that supplied with a Graphic camera. The copying lamps are made from a pair of gooseneck desk lamps. The ones that are fitted with C-clamps are the easiest to convert. Fig. 6 shows how the clamping brackets are altered by sawing on the dotted lines. The lamps are attached to the sides of the enlarger by fastening the brackets with small machine or thumbscrews. Being flexible, the lamps can be left permanently attached to the enlarger

and swung out of the way. If the lamps are connected to a common plug, fit them with a plug that can be distinguished readily from the one on the enlarger. No. 1 photo-floods or regular enlarger bulbs can be used in the lamps. The latter are less brilliant and permit more latitude in making exposures.

The periscope viewer which rests on top of the adapter back can be made of wood, metal or cardboard. The sides of the original were of wood and the top and nose-piece of cardboard. As the size of the viewer must be made to fit the head of the particular enlarger, no dimensions are given. A piece of mirror is mounted in the viewer at a 30-deg. angle, as shown in Fig. 5, and the inside of the viewer is painted dull black to eliminate light reflections. The ground glass on the adapter back is marked off in 1-in. squares. Rule the lines on the glossy side of the glass, using a draftsman's ruling pen and India ink.

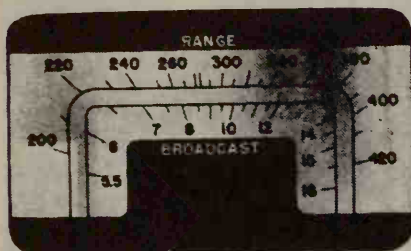
The viewer and adapter back are placed in the enlarger by removing either the lamp house or the condenser lenses. The lenses were removed from the enlarger pictured in Fig. 7. Three thumbscrews



METER DIAL

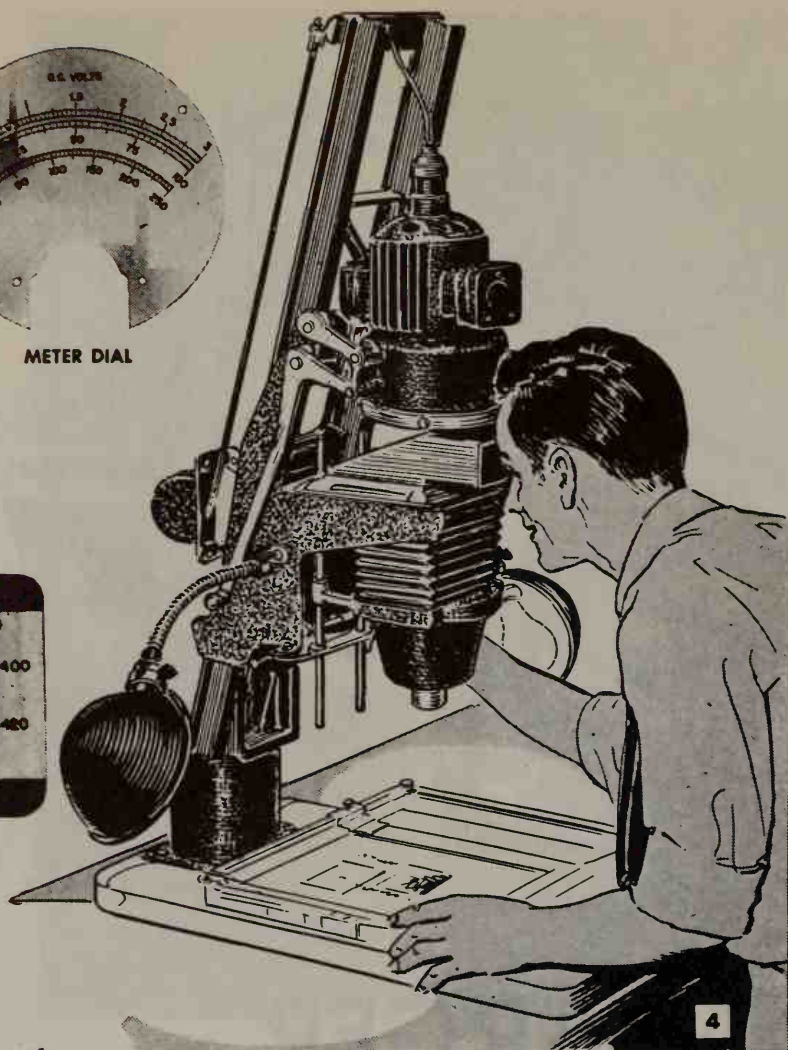


INDICATOR MARKERS



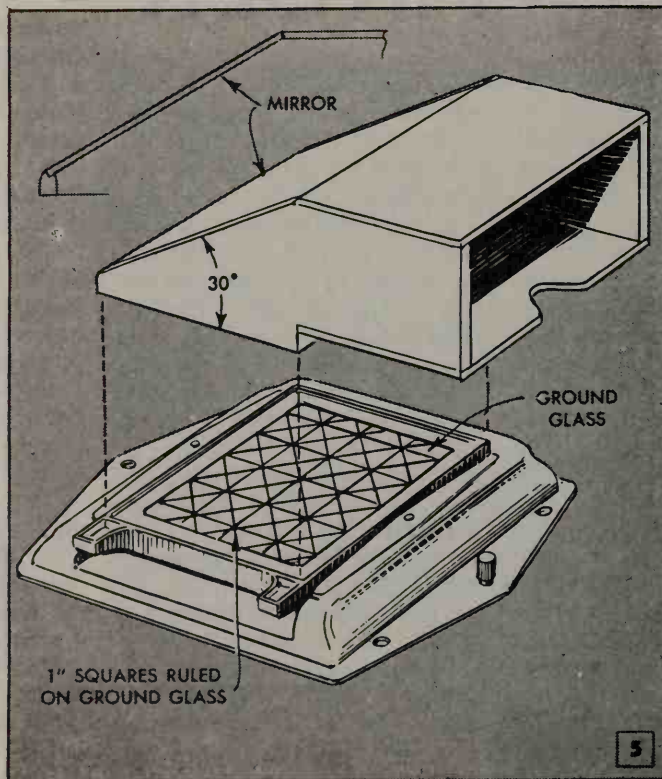
AIRCRAFT RADIO DIAL

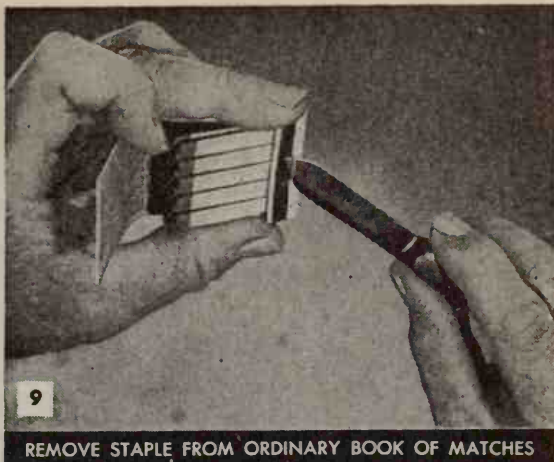
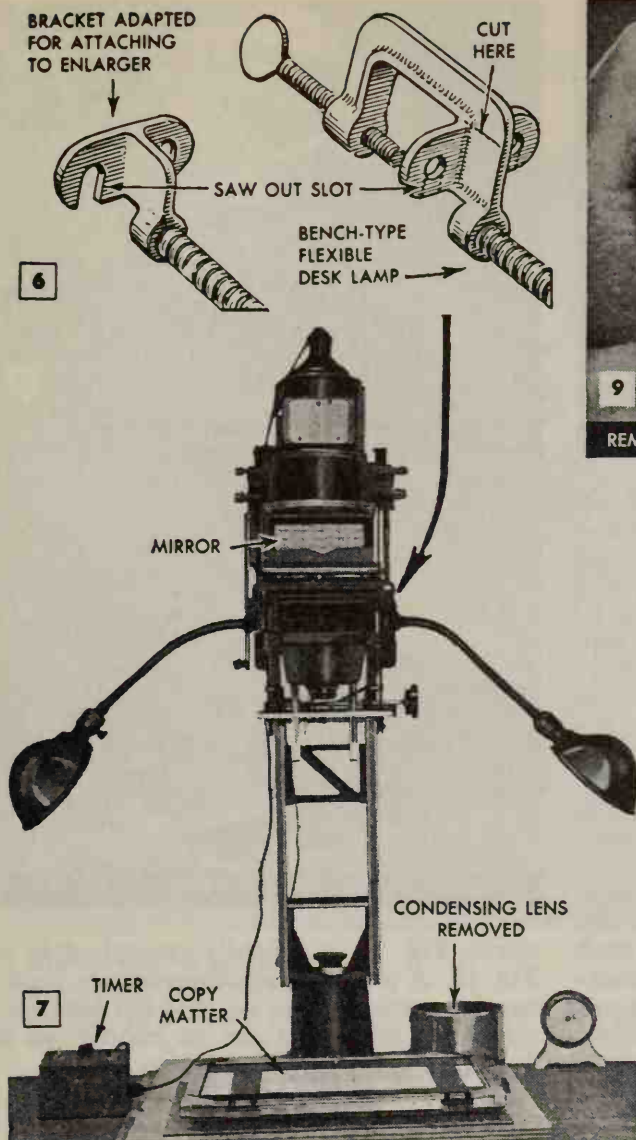
COMMERCIAL COPY



usually hold the lenses in place. The adapter back is placed over the open end of the bellows and the viewer goes on top of the adapter. The enlarger is now set up to make copy negatives.

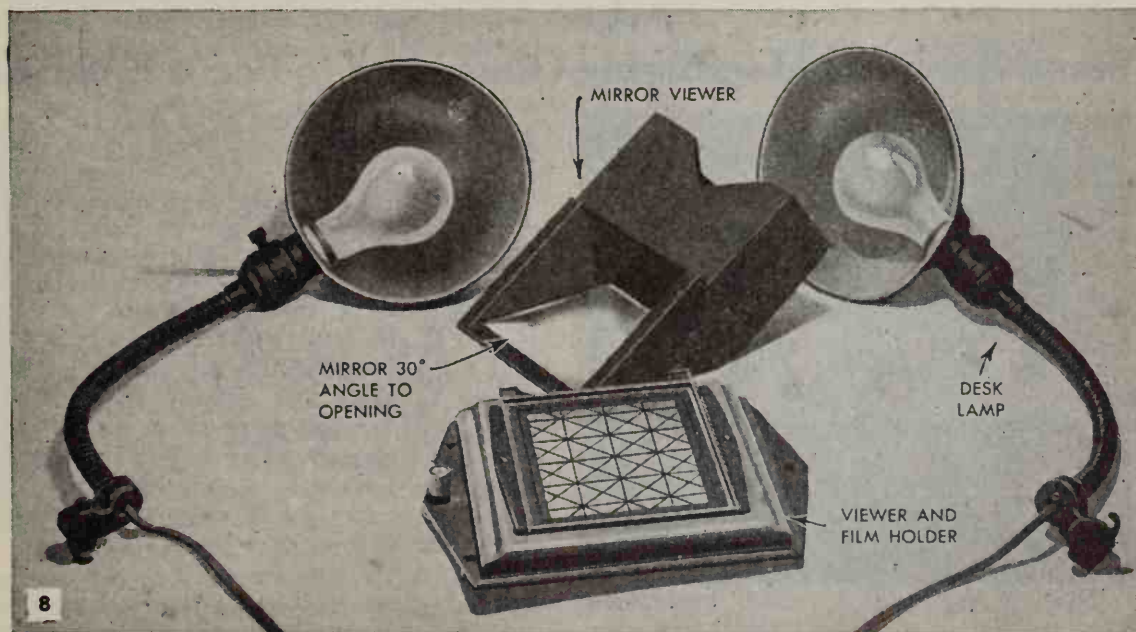
To make a copy negative, place the material to be copied on the enlarger easel. With the lens aperture opened all the way, peer into the viewer and focus the copy sharply on the ground glass, bringing it to the desired size. With this done, slip a loaded film holder in the adapter. Now you are ready to make the exposure, much the same as you would with a camera. Set the aperture of the enlarger lens at its smallest opening, pull the slide from the film holder and turn on the copying lamps. Several test negatives usually will have to be made to obtain the correct exposure the first time. If super-XX film is used and the lens opening is set at $f:32$, an exposure of from five to seven seconds is suggested. From here on, the





negative is processed and printed in the usual manner.

Examples of what you can do with your enlarger when set up for copying work are shown in Figs. 1, 2 and 3. These include birthday and Christmas cards, birth announcements, personalized match-book covers and numerous types of commercial copy, which can be produced by copying photos and drawings from magazines, actual retouched photographs, etc. In fact, there's little that cannot be copied, the only limitation being the area your enlarger will cover. The Christmas card pictured in Fig. 1 was made with three negatives. The printed verse was copied from an old Christmas card and the third negative was made by shooting a couple silhouetted against a sheet brightly lighted from behind. A print was made of





TAKE OUT MATCHES AND DISCARD COVERING

the third negative, and the images cut out and pasted on a drawing of a window and star. This composite print was then placed on the enlarging easel and copied. The complete card was printed at one time by taping the negatives in position in a contact printer. Finally, the candles were hand-colored. The second card pictured in Fig. 2 also was made from a composite, the card featuring on the cover how the scene pictured on the inside was made.

Personalized match-book covers are fun to make. First a copy negative is made from the photo or sketch you plan to use and then it is printed or enlarged on double-weight paper slightly larger than the finished size of the cover. After this, each personalized cover is applied to commercial book matches by simply pulling out the staple, Fig. 9, removing the matches, Fig. 10, and then replacing them in the new



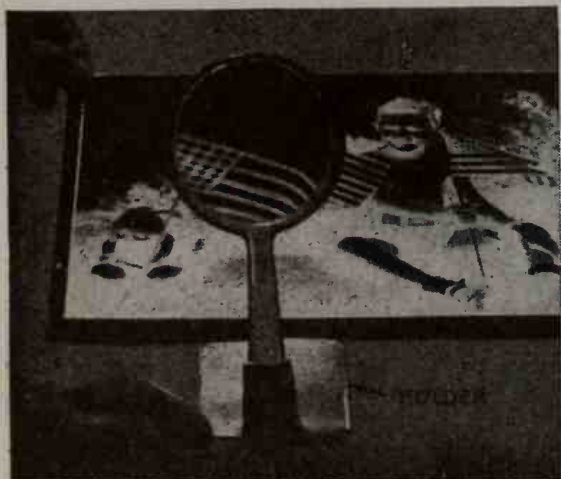
PLACE MATCHES IN NEW COVER MADE OF PHOTO PAPER



FASTEN MATCHES TO NEW COVER WITH STAPLE

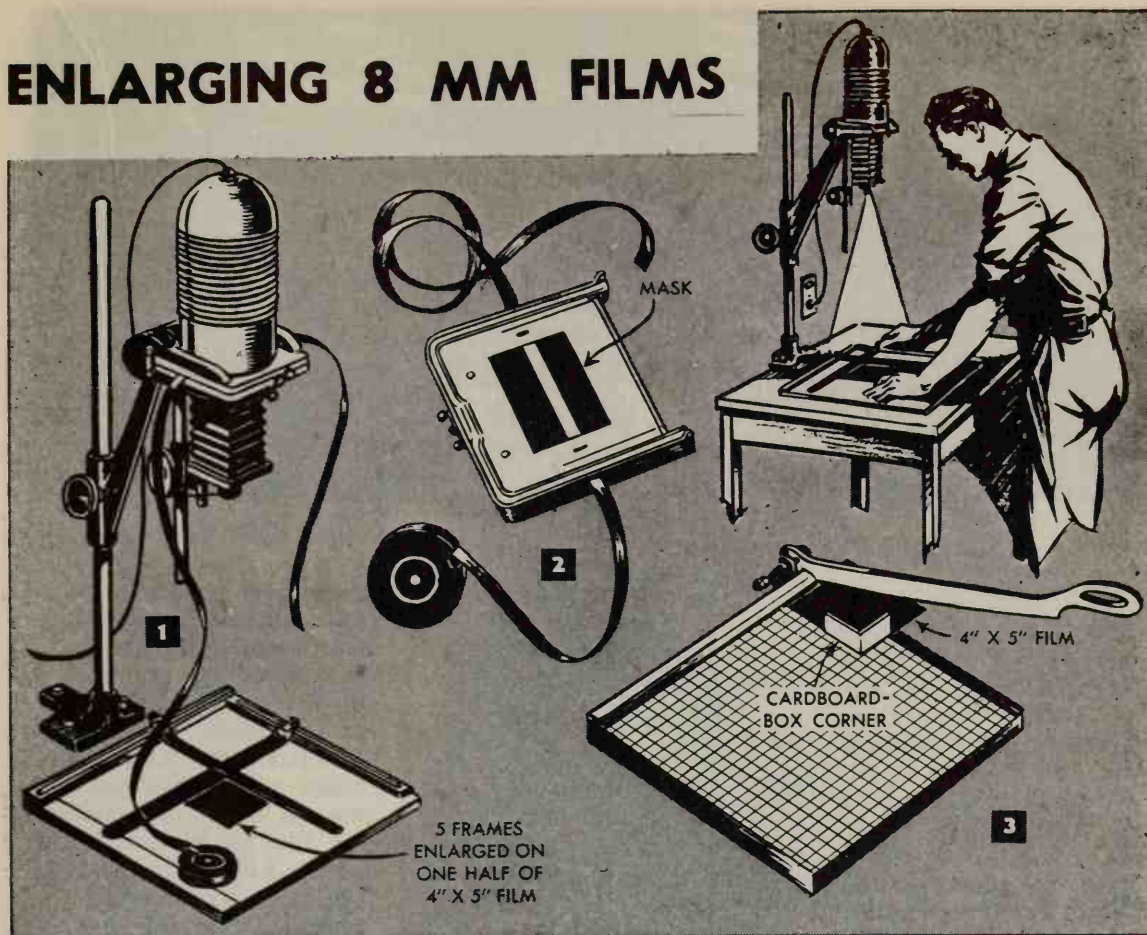
cover, Fig. 11, and finally restapling as in Fig. 12. A prepared striking-surface liquid can be purchased for coating the new covers and a simple jig can be improvised to facilitate applying the solution neatly.

Stand Supports Magnifying Glass Used to Focus Enlarger



When a magnifying glass is used to inspect a projected image from an enlarger as an aid in getting sharper enlargements, time lost in focusing the glass continuously during the inspection can be saved if the glass is supported in a holder as shown. A dime-store reading glass will do, and once it is adjusted in the holder to suit the focal length of the lens, inspecting an image is just a matter of setting the holder on the enlarging easel and looking through the glass, thus leaving your hands free to adjust the enlarger. The holder is shaped from thin sheet metal to provide a base and a socket is formed to take the reading-glass handle.

ENLARGING 8 MM FILMS



All that's needed to make enlargements from 8mm. movie film is an enlarger, some 4 by 5-in. cut film and a fine-grain developer. The procedure is much the same as when making any enlargement except that the movie-film positive is projected on regular film first to produce the negative from which the final print is made. The film for the negative should be a fine-grained panchromatic type.

First step, of course, is selection of the scenes from the movies that you wish to enlarge. Because the picture will be magnified many times, the frames should be those which are in sharpest focus. Place the film strip in the negative carrier of the enlarger so that at least five frames of the scene can be projected at the same time, and be sure to mask the strip carefully, Fig. 2. If the enlarger has a glassless carrier, place one edge of the strip so that its entire length is held between the carrier plates to prevent possible buckling. Then, as before, mask off the rest of the opening. Let the loose ends of the film hang down out of the way, Fig. 1.

In the darkroom, cut the 4 by 5-in. film lengthwise so there are two strips, each 2 by 5 in. If a cardboard-box corner is used to position the film on the trimmer, Fig. 3,

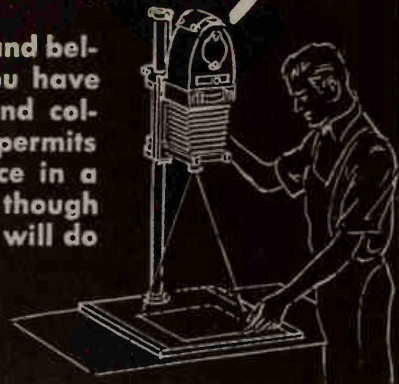
the task will be much easier and the results will be accurate. To project the movie film, place the carrier in the enlarger and focus on the easel so that each frame is about 1 in. wide. Then place the cut film on the easel and project the 8mm. frames on it. Five frames should about cover the length of the strip.

With five frames on the same film, it's possible to give each one a different exposure, much in the same way that a test strip is made on enlarging paper. At first it will be necessary to do a little experimenting; for example, try exposures of 1 sec., 2 sec., 4 sec., 8 sec. and 16 sec. with the lens set at f:11. However, the exposure will depend somewhat upon the light source in the enlarger and the speed of the film being exposed. Once the approximate exposure range necessary for the materials and equipment you have has been determined, the 5-test strip should cover scenes from most films.

The negatives that are made will be about the same size as 35mm. film. As mentioned, use fine-grain developer and avoid too much contrast. Then select the best frame and enlarge it as you would any other negative, using a matte-finish or similar paper to avoid grain.

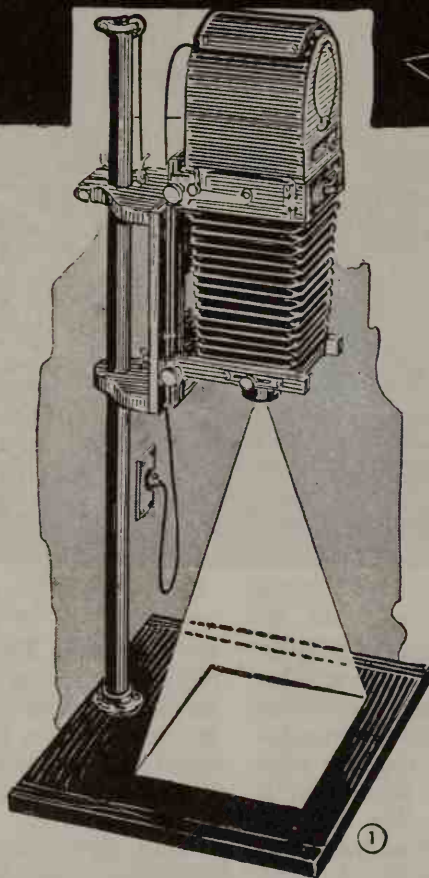
Camera Becomes Enlarger

Your camera supplies the lens and bellows for this enlarger — all you have to make is the lamp house and column. Quick-change adapter permits camera to be clamped in place in a jiffy. View camera is preferred, though most any folding-type camera will do



IF YOU have a bellows-type camera, it's likely that it can be used as an enlarger simply by removing the ground glass and constructing a lamp house and column to fit. The enlarger described here, Fig. 1, was made with a 5 by 7-in. view camera, but others can be adapted by altering the size of the lamp housing, column and platform to suit your camera. It may be necessary, in this case, to experiment and determine the height of the standard and the position of the camera in relation to the enlarging board and the focal length of the lens so the negative is properly projected.

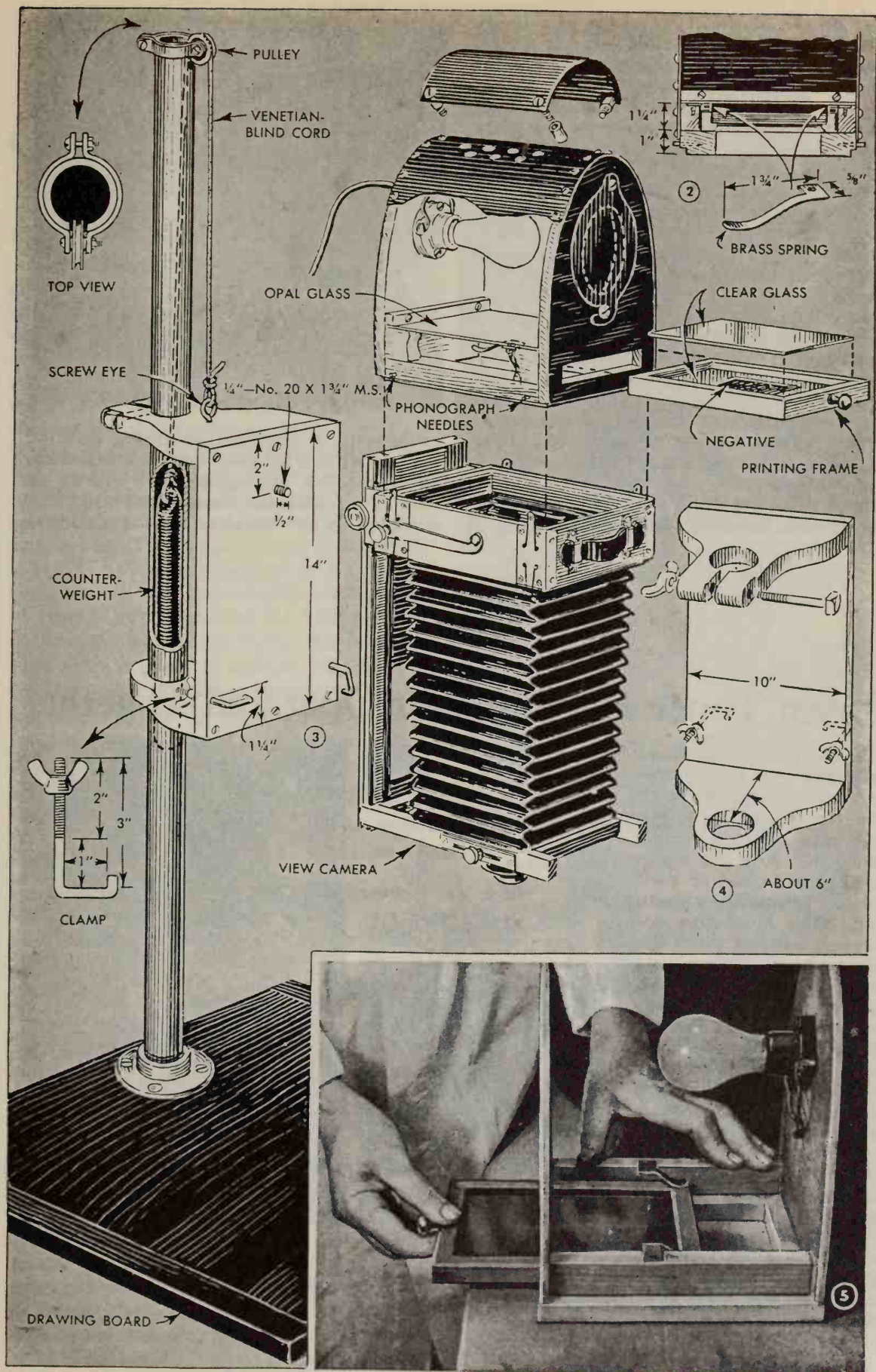
Two pieces of plywood form the ends of the lamp house and are cut in the form of a parabola. Only the part that shapes the contour of the sheet-metal reflector need be a true parabolic curve, however; the rest is straight. Cut a 5-in. circle in one piece and fit it with a sheet-metal access door as indicated in Fig. 2. This is provided for the removal of the lamp. In the same piece cut an opening for the negative holder, which may be a contact printing frame of a size to fit the camera. The lamp base is mounted on the other endpiece and a hole is drilled above the socket for the lamp cord. The lamp should be centered so light is distributed uniformly over the opal glass. This can be checked with a light meter as in Fig. 6. The hardwood sidepieces that serve as guides for the negative holder, Fig. 5, are cut and fitted with spring



clips, right-hand detail of Fig. 2. Place the opal glass and secure it with two small strips on the endpieces. After the ends and sidepieces are assembled, the sheet-metal cover is added. To provide adequate ventilation, holes are drilled in the top. A baffle is provided for the ventilation holes and is held in place with spacers and machine screws. The interior of the house is finished with aluminum paint. After rabbeting the ends and sidepieces to fit the back of the camera, drive in phonograph needles to engage the ground-glass retaining clips. If you use a contact printing frame as a negative holder, Fig. 5, remove the back and

any clips on the sides that may have been used to hold the back in position. A knob is added to remove and insert the holder. Two sheets of plate glass are cut to fit the holder and the negative is carried between them. If desired, a set of masks can be made for different sizes of film down to 35-mm. film. Paint all exterior parts of the lamp house a dull black.

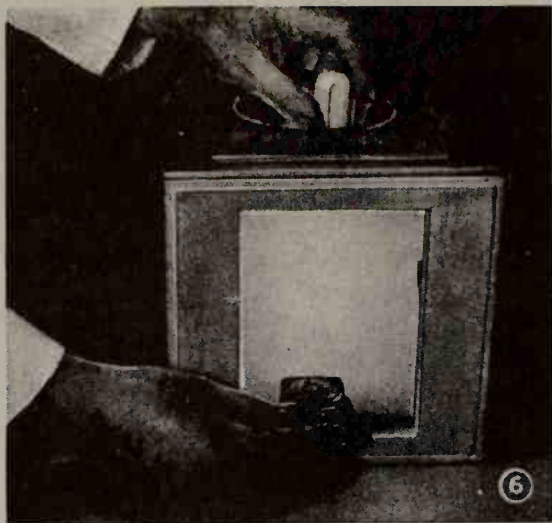
To make the camera platform and column, cut a piece of 1¼-in. pipe—48 in. long in this case—and thread one end. Notch the other end and fit it with a collar and pulley as in the upper detail of Fig. 3. The platform consists of a base and the two endpieces, Fig. 4. The lower piece serves as a guide only, and the upper piece, which is slotted, clamps the platform in position when the wing-nut-and-bolt adjustment is tightened. The camera is held in posi-



tion on the platform by means of a $\frac{1}{4}$ -in. No. 20 tripod screw, which fits the tripod base, and two adjustable clamps that fit over the bed. Here again it will be necessary to take measurements from your own camera to determine the size of the platform and location of the screw and clamps.

When the platform is attached to the camera, it should be weighed and a lead counterweight made which rides inside the pipe, Fig. 3, using Venetian-blind cord to attach it. The weight should be equal to that of the camera and platform. This will make raising and lowering the camera easier. A suitable base for the enlarger is made from a drawing board of the type used by students. A $1\frac{1}{4}$ -in. floor flange is screwed to the center of one side. The column is screwed into this. All exposed wood parts should be finished in a dull black color to prevent unwanted light reflections.

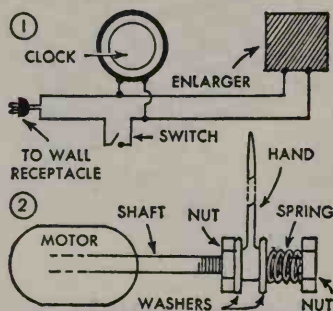
Although no particular type of switch is indicated, a snap switch can be installed in the cord, or, to leave both hands free, a foot switch can be used. The latter usually is



preferred. A standard enlarging bulb of the proper size for your lamp house should be used. Any enlarging easel will do as long as it fulfills the requirements of your work and is not too large for the platform.

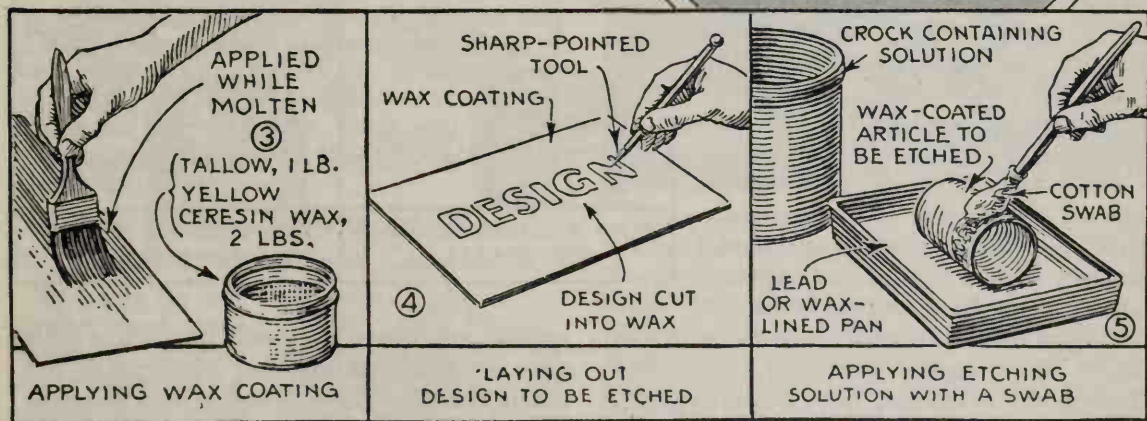
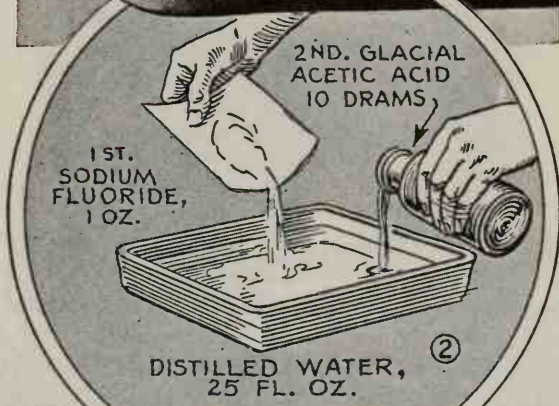
Photo Timer and Enlarger Operated Together

If a switch is connected in series with the enlarger and in parallel with the timer, detail 1, the two will operate simultaneously. Any self-starting electric clock is used for this setup. The minute and hour hand are removed, leaving only the second hand. With a little work a reset device can be installed. The motor is removed and the shaft is threaded. Then the hand is replaced and the two washers, nuts and spring shown in detail 2 are added. The knob and catch which are shown in the lower left-hand detail are for the purpose of returning the hand to the 12 o'clock position. In operation, the knob is pushed in against the spring so the catch will engage the hand, and when the hand is set and pressure is removed, the catch will spring back.



Etching GLASS and METAL

WITH the use of proper solutions anyone can etch unlimited designs on metal and glass articles at home or in the small shop. Tools can be marked permanently with the owner's name, glassware can be etched with almost any type of design, and ornamental metal work can be made more beautiful. A great number of etching solutions are composed in part or in whole of acids that are caustic to the skin and will damage materials such as wood and clothing. Great care is necessary in their use, and spilling, splashing, or inhaling of the vapors must be avoided. If acid is accidentally spilled on your skin, flood the surface immediately with water to wash it off, spreading the acid as little as possible, and then cover the affected area with a paste of sodium bicarbonate (baking soda) or sodium carbonate (washing soda). When the etching job has been finished, the solution should be stored in a glass-stoppered bottle (unless it contains hydrofluoric acid) and clearly labeled, or

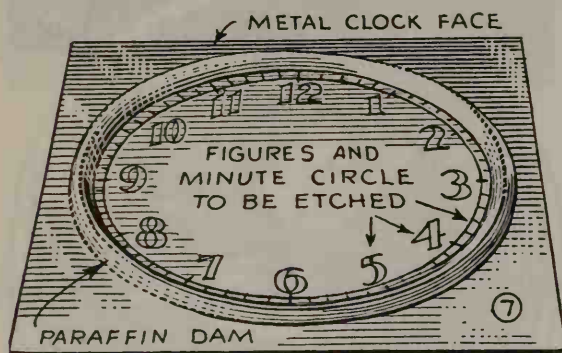


it should be poured down the floor drain and rinsed away with a large quantity of water.

In diluting, always add the acid slowly to the water in a stoneware crock with constant stirring, as shown in Fig. 1. Acid solutions should be kept only in glass or stoneware vessels, except hydrofluoric acid, which attacks glass and is sold and

stored in lead or wax containers.

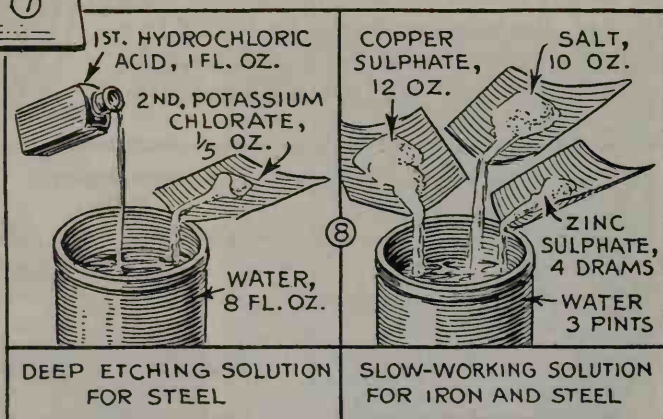
Etching Glass: Designs and lettering can be etched on glass with a solution made by dissolving sodium fluoride, 1 oz., in distilled water, 25 fl. oz., in a lead tray or bottle, Fig. 2. No material other than lead should be used for the container. To this solution is added glacial acetic acid, 10 drams, after which the mixture is stirred



with a stick. The solution is extremely caustic to the skin and causes painful sores that are slow to heal. As the solution does not keep well unless stored in an airtight wax or lead bottle, only a small amount should be mixed at a time. Glass to be etched is cleaned thoroughly with soap and water, rinsed thoroughly, and then covered with a mixture of tallow, 1 lb., and yellow ceresin wax, 2 lbs., applied while molten with a brush, Fig. 3. The design or lettering is scratched through the wax layer with a sharp-pointed tool as in Fig. 4. If you like, the design can be laid out on paper and traced onto the wax, or a stencil can be used. The solution is then applied with a swab as shown in Fig. 5. If more convenient, the wax-coated article can be dipped in the acid solution, or the acid can be poured on the work after providing a paraffin dam as in

Fig. 7. The surface to be etched must be left in contact with the solution long enough to etch as deeply as required. The etched article is washed well in plain water, after which the wax can be removed either with gasoline or hot water.

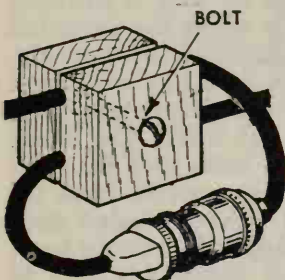
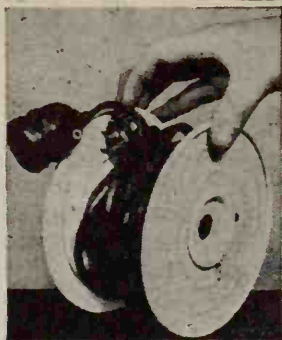
Etching Steel: An effective etching solution for use on steel is composed of nitric acid, 2 fl. oz., and glacial acetic acid, 1 fl. oz. A deeper etch with more contrast can be made by adding hydrochloric (muriatic) acid, 1 fl. oz., to water, 8 fl. oz., and dissolving in this solution potassium chlorate, $\frac{1}{5}$ oz., Fig. 8. After cleaning the metal, designs, lettering and monograms can be laid out on the metal with asphaltum paint. When the paint has dried, the etching solution is swabbed on with a wad of cotton string tied to the end of a pine stick. The acid will etch all exposed parts of the metal with which it comes in contact. When the etching has reached the desired depth, the solution is washed off with water, and the asphaltum paint removed with gasoline. To mark tools and other metal articles, stamp the name on metal surface, using a rubber stamp and asphaltum paint in place of ink, as in Fig. 6. The paint may be applied to the



rubber stamp with a small brush if a little care is used. After the impression has dried, the solution is swabbed over the area to be etched, which should be sufficiently large to contrast the non-etched letters. When work has been completed, lettering will stand out in relief above an etched background. A less corrosive etching solution for iron and steel is made by dissolving copper sulphate, 12 oz., zinc sulphate, 4 drams, common salt, 10 oz., in water, 3 pts.

EXTENSION CORDS

Sharp kinks in extension cords caused by hanging them from hooks or nails are likely to result in broken insulation and dangerous exposure of the wire. The cords can be stored conveniently without kinking or tangling simply by winding them on discarded metal wire spools. These spools, on which wire is wound for shipment from the manufacturer, can usually be obtained from a local hardware or electrical-supply dealer.

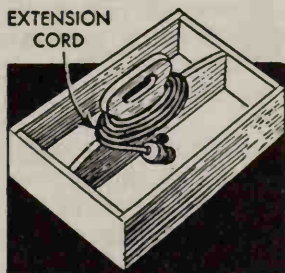


Made from two blocks of wood bolted together, this clamp prevents breaking the connection of an extension cord. It is especially handy when using an extension cord to operate portable

electric tools, hedge shears, or a vacuum cleaner where there is a considerable strain on the connection. The clamp is made by drilling two parallel holes, slightly smaller in diameter than the extension cord, through a wooden block. Then the block is sawed apart lengthwise through the centers of both of the holes. The cords are placed in the holes, as shown, and the two pieces of the block are bolted together. Thus, any strain on the extension cord will be absorbed by the block and the connection will not be broken.

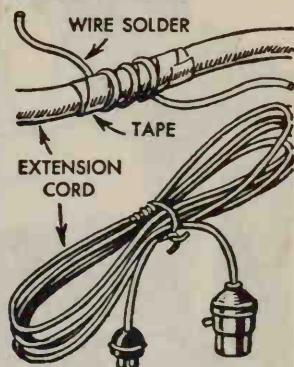
Toolbox Handle Serves as Reel For Winding Extension Cord

To keep an extension cord from becoming tangled or buried under an assortment of tools when stored loosely in a toolbox, one man made the center partition of his toolbox into a combination handle and reel. The partition is jigsawed from one piece in the shape shown, a handhole being cut in the top. When not in use the extension cord is wrapped around the handle, reeling off smoothly when required.



Wire Solder Used as Tie String On Electrical Extension Cord

To keep a long extension cord looped when not in use, tie it with a length of wire solder as indicated. The solder will always be at hand if it is given two or three turns around the center of the cord and taped in place.



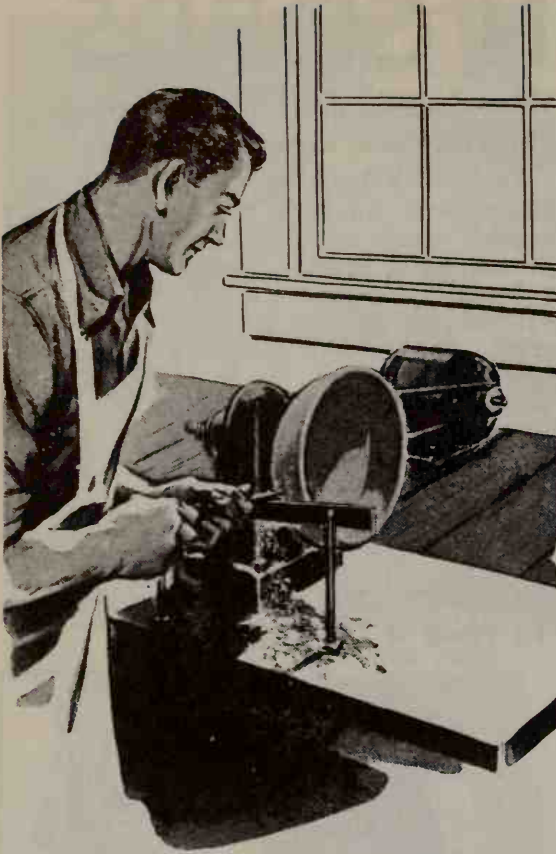
Extension Cord Wound on Reel To Hold It Off the Floor



If an extension cord is wound on a reel it can be set directly on your work, and the cord will be kept off the floor where it might be walked on or otherwise damaged. A reel can be made from a metal spool of the type used for holding lamp cord or water-pump packing. A hole is cut in the reel as shown to take the cord, which is protected from abrasion by a rubber grommet. After the cord has been pulled through the hole so that the socket seats tightly in the spool core, the core is filled with tar to hold the cord, which then is wound on the reel and fed out as required. The cord can be kept from unwinding by a notch filed in the lower flange and smoothed to keep the insulation of the cord from being cut. If desired, a wire cage may be attached to the reel to protect the lamp.

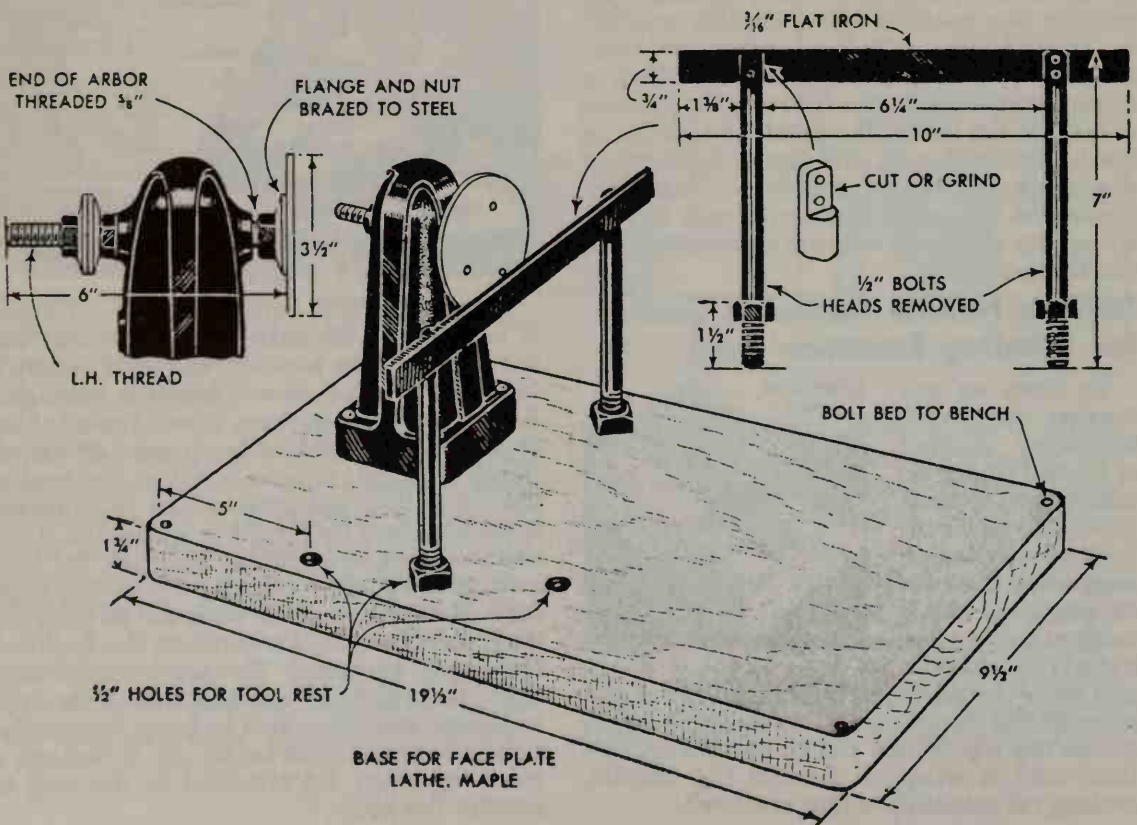
FACEPLATE LATHE

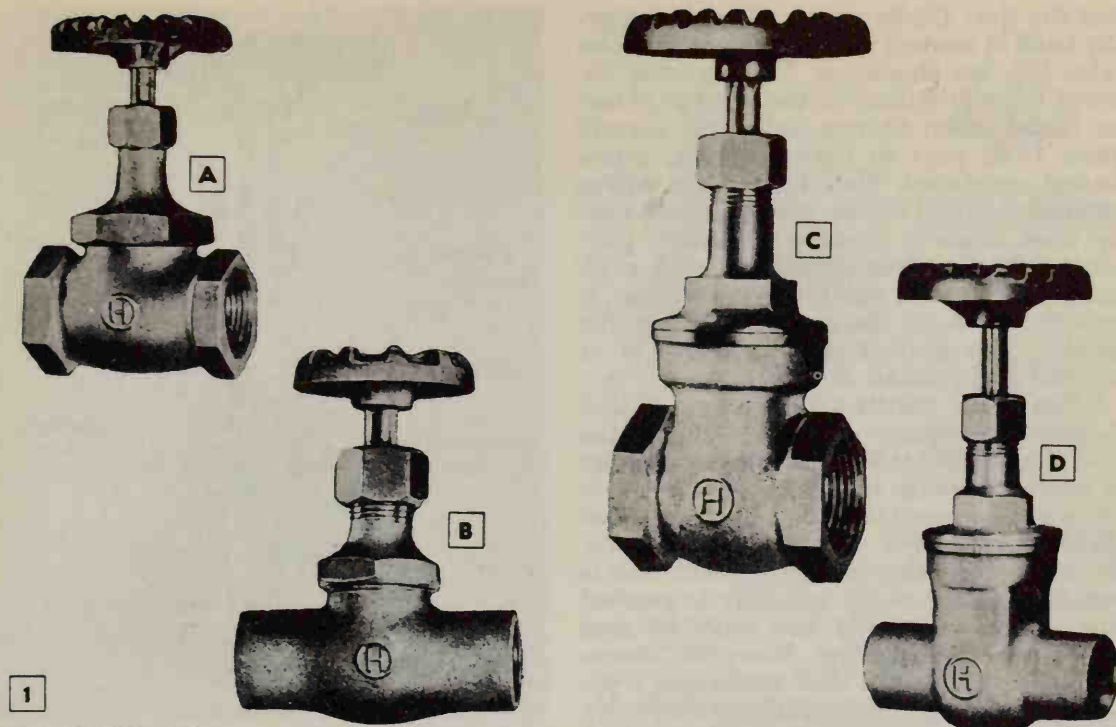
From Polishing Head



Tool rest can be positioned directly across the bed or set to permit turning edge of the work. The hardwood lathe bed is bolted to the top of the workbench

IF YOU ARE beginning a home workshop on a limited budget, the mere price of a polishing head will provide you with the basic part needed to make an excellent faceplate lathe, ideal for turning bowls, picture frames and trays. Fitted with a faceplate at one end and a grinding wheel at the other, you'll have a most convenient setup for sharpening your turning tools. Although a suitable faceplate can be purchased to fit the arbor of the polishing head, one can be made by centering and by brazing one of the arbor nuts and flanges to the blank cover of an outlet box. The faceplate end of the arbor is cut off so that it projects approximately $\frac{5}{8}$ in. to bring the mounted work close to the polishing-head bearing. The polishing head is bolted to a hardwood base, and a tool rest is made from two $\frac{1}{2}$ -in. bolts and a length of flat steel. The heads are removed from the bolts and flats are filed at the upper ends to provide seats for riveting the flat steel. The threaded ends of the bolts engage holes drilled in the base, the height of the rest being adjusted to bring its top edge about $\frac{1}{8}$ in. above the center line of the faceplate.





Hammond Brass Works photos

FAUCETS AND VALVES

CONTROL OF WATER SUPPLY is the function of valves and faucets, which also are referred to as cocks, bibbs, stops and taps. Valves and sill cocks are used on pipe lines; faucets are installed at fixtures. Having a sufficient number of valves in a water system enables you to shut off any branch individually instead of the entire system. Being able to do so quickly may prevent flooding and costly repairs. Valves in home plumbing lines usually are cast bronze and have portions machined and threaded for trimmings. See details A and C of Fig. 1. The port ends (ends that connect to lines) may be tapped for screwing to pipe or may be smooth for soldered joints to tubing as in details B and D. Since valves are of different types for specific purposes, they should be installed accordingly.

Gate valves: A gate valve, of which a cross-sectional view is shown in Fig. 2, has a sliding wedge that is moved across the waterway, usually by means of a threaded spindle or stem. This may be the rising or the nonrising type; the latter type has the shorter bonnet. A gate valve is primarily used to completely shut off or completely open a waterway, but not to control the volume of flow. Either port (opening) of a gate valve may face the pressure side of

the line. The chief advantage of a gate valve is that it permits complete passage of water without adding appreciable resistance to the flow. Therefore gate valves should be used on all supply lines that are in constant use, particularly where water pressure is low.

The sliding wedge or gate may be either solid or split, as in details A and B of Fig. 3. One part of a split wedge pivots on a rounded seat on the other so that they automatically adjust themselves to the angle of the double seat. The seat may be part of the body casting ground to a smooth surface, or it may have inserted corrosion-resistant rings. The waterway through the seat corresponds in size to the size of pipe on which the valve fits. Often the bonnet that holds the spindle in place is attached to the body with a union ring. The spindle may be either the stationary or the traveling type. When leakage develops between disk and seat, it is generally necessary to replace the valve because it is difficult to reface the seat, although new disks may be installed.

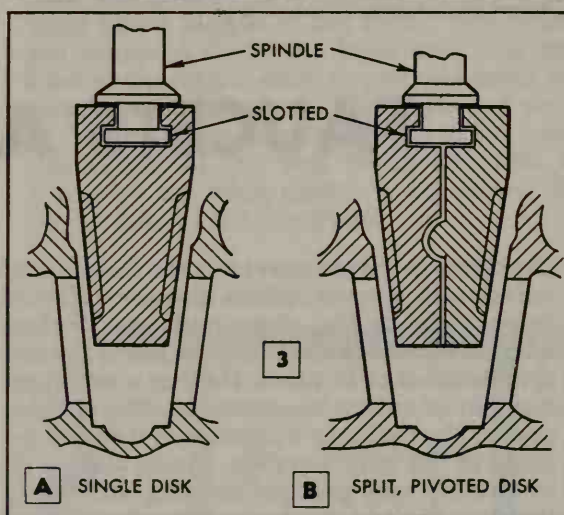
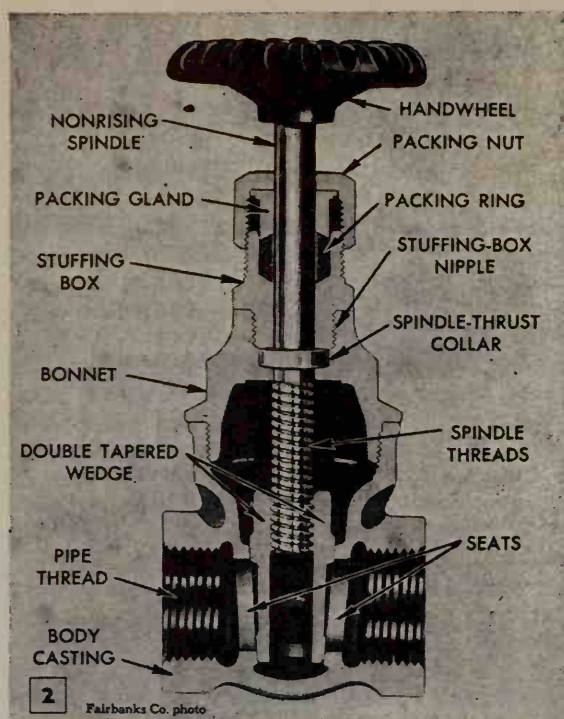
Globe and angle valves: Wherever a valve must be opened and closed frequently, and water pressure is sufficiently high, a globe valve, Fig. 4, is customarily used in spite of the added resistance it introduces

into the line. Globe valves also are generally used to control volume of flow. A globe valve has two chambers. The partition between them is drilled for the passage of water, which must change its course several times from port to port, Fig. 5A, introducing resistance. Therefore, globe valves generally should not be used in water-supply lines to serve occasional shut-off purposes only. To close a globe valve, a disk, usually faced with a composition washer, is brought down on the seat by turning the spindle. The ground seat may be flat or beveled as in detail B of Fig. 5.

Often globe valves are installed so that the water pressure is exerted under the disk. When so installed, spindle packing can be replaced while the valve is closed—or when fully opened if it has a back seat that prevents leakage of water past the spindle. When a globe valve having no back seat is installed so that water pressure is exerted downward, the supply line must be shut off for packing the stem. However, downward pressure on the disk minimizes trouble from leakage, tends to keep the valve closed when not tightly shut off by hand, and in case of failure of threads on the spindle, the valve will close automatically instead of “blowing open.” When a globe valve is installed on horizontal pipe so that the handle sets vertically either above or below the valve, water will not drain out of the line completely, as indicated in detail C. To avoid this trouble, arrange the spindle horizontally so that water can pass through the seat opening as in detail D.

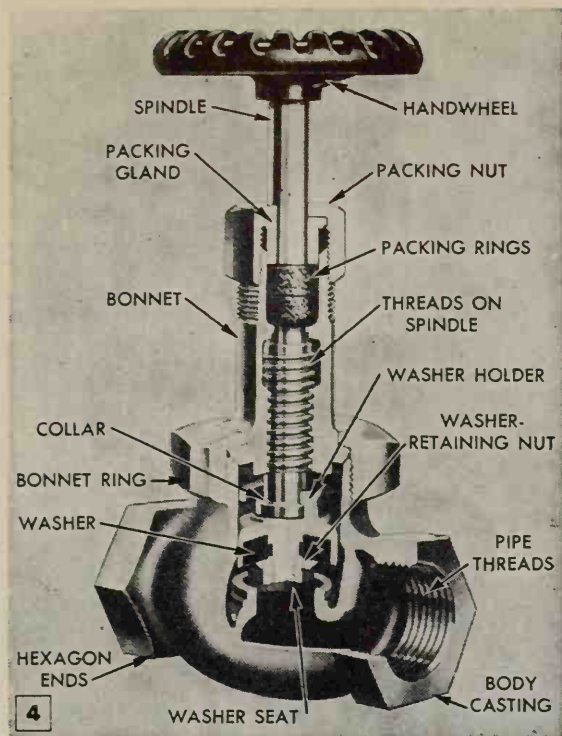
An angle valve is similar to a globe valve but has its ports at right angles, Fig. 6. Usually the water passage is larger than it is on a globe valve, and since there is only one change of direction of flow, less resistance is introduced. An angle valve installed at a turn in piping eliminates the need of an elbow, and often is preferable to using a globe valve and an elbow.

Reconditioning globe and angle valves: Most globe and angle valves have a composition washer which should be replaced at the first sign of leakage. After removing the spindle assembly, loosen the screw or nut holding the washer. Remove the washer and carefully scrape away all traces of it that may have stuck to the disk, Fig. 7. The new washer, held either by a screw or nut, should be tightened in place securely. If a nut is used to hold the washer, it is prick-punched to lock it on the projecting threaded end. For valves on hot-water lines, use only the hard or semihard washers. The semihard washers are also used on cold-water lines, but the soft, resilient type is preferable. Washers come in various diameters and should be selected to fit the washer holder accurately.

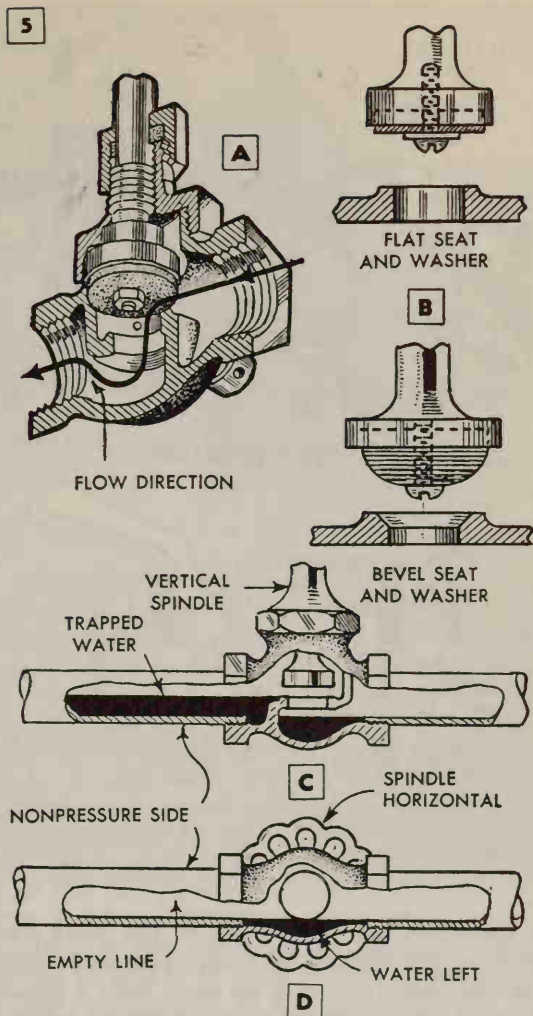


When a new washer does not produce a tight seal, the valve seat requires dressing. Some globe valves have renewable seat inserts. To dress the seat of a small globe or angle valve, you use a standard reseating tool of the kind shown in Fig. 26, which also is used for reseating compression faucets. Use very slight pressure on the reseating tool and remove only as much metal as is necessary to obtain a smooth seat. When finished, remove the chips before reassembling. If a valve seat has been weakened by repeated dressing, or is damaged beyond repair, a seat insert, Fig. 27, is less expensive than replacing the valve. However, as the insert restricts the opening, it should be used only if water pressure is adequate.

Globe and angle valves not fitted with composition washers, but having a metal-

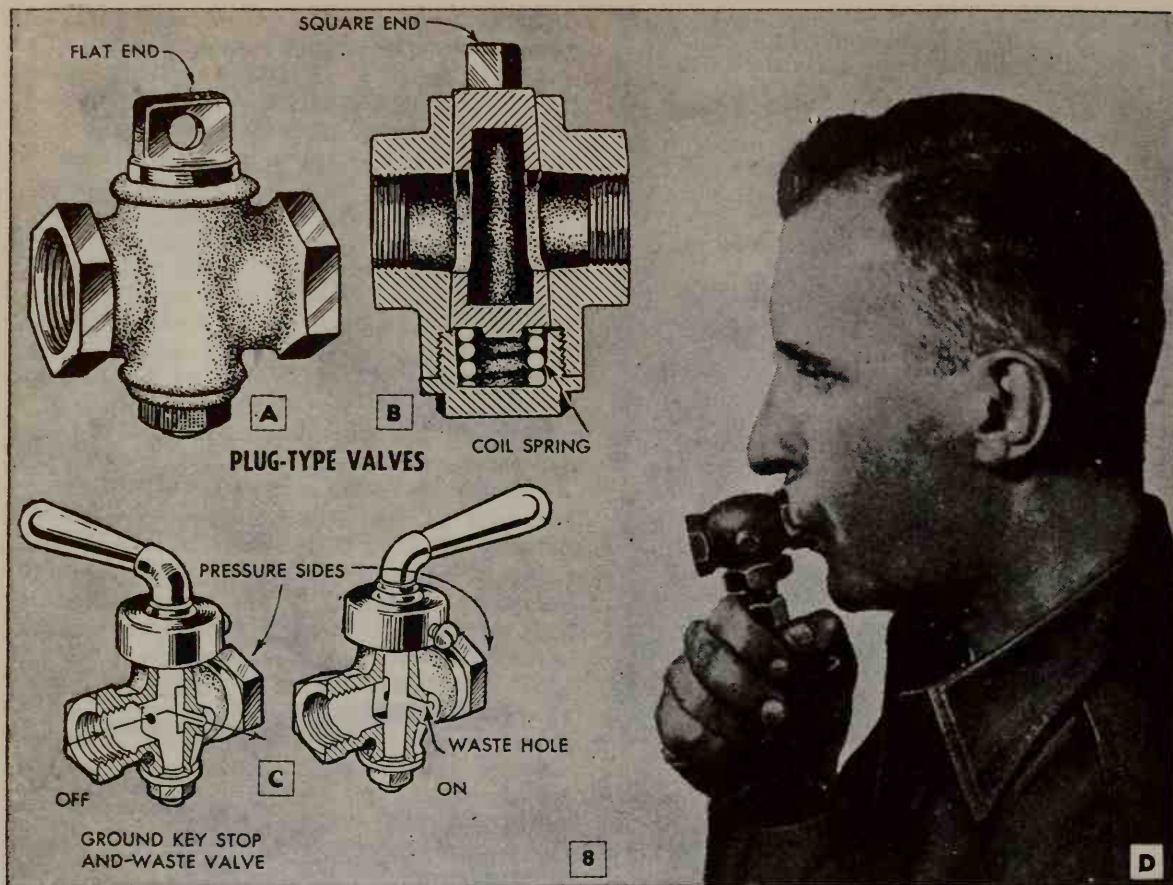


ANGLE VALVE
Fairbanks Co. photos



to-metal seat contact, are sometimes preferred for hot-water lines. Leaky seats of this kind must be reground. Some valves have provision for locking the disk to the spindle, such as a grooved locknut and a small hole in the spindle for a holding pin, permitting the spindle to be used as a grinding tool. After locking the disk to the spindle and putting a moderate amount of grinding compound between disk and seat, screw down the union ring tightly with the fingers but then back it up exactly one full turn to keep the spindle perfectly vertical. More than this would allow the spindle to be tilted while grinding. To grind, turn the spindle back and forth not more than a quarter turn, a number of times at different points of contact between disk and seat. Do not overgrind. Clean out the grinding compound thoroughly before reassembling.

Plug or key valves: These, shown in Fig. 8, have a tapered, ground plug fitting a mating tapered hole or seat. An opening through the plug provides an unobstructed waterway producing minimum resistance to flow. In this respect, it is comparable to a gate valve. A quarter turn opens and closes the valve. The common type shown

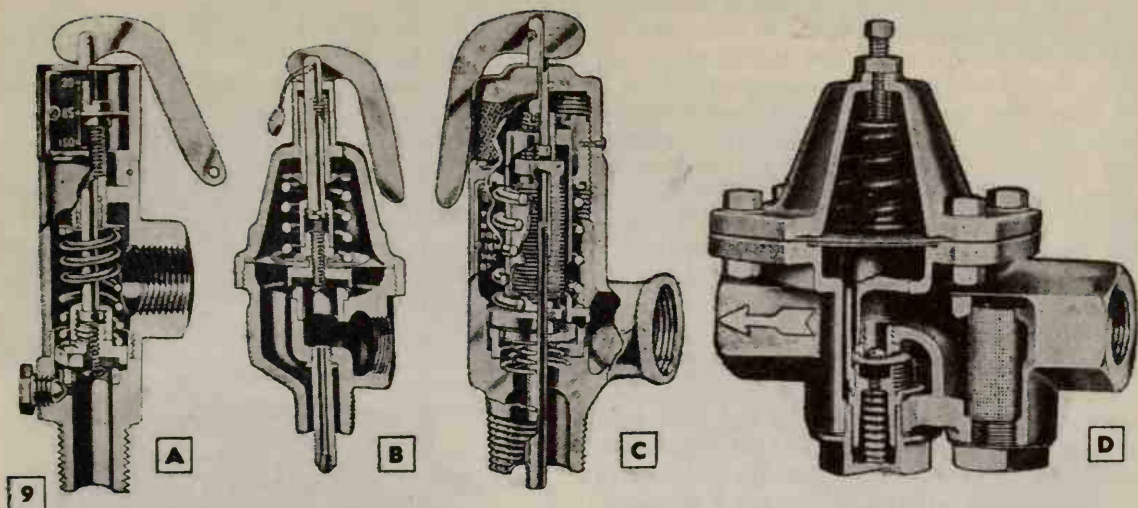


in detail A has both ends of the plug extending outside of the body. The large end may be flat, or square so as to take a small wrench, or it may be provided with a handle as in detail C. The small end usually is threaded for a nut which holds the plug snugly in its seat. On the type shown in detail B the arrangement is reversed; the small end is the handle end and the large end is placed under pressure of a coil spring. This type generally causes less leakage. Because of the spring there is less danger of distorting the plug in case the water is frozen.

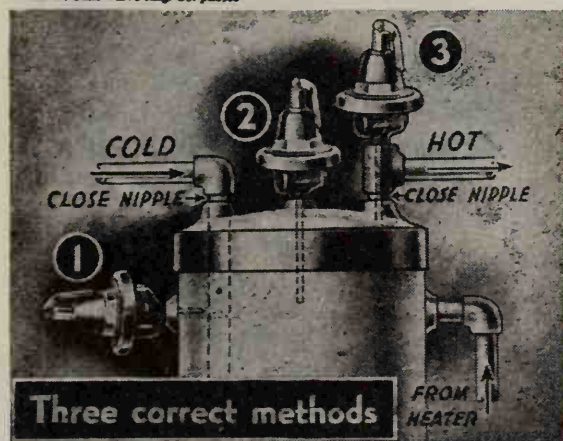
In a plug valve, sand or grit in the water is likely to jam or scratch the ground surfaces, resulting in leakage. Therefore, these valves are not durable when subjected to constant use, but are very serviceable for occasional shut-off purposes. They often are required by code as a main shut-off valve on the street side of a meter, in which case they should be of the drainable type. The same kind also may be used on lines supplying sill cocks where globe valves introduce too much resistance to flow. Curb stops are usually of this type also. When leaky, such valves must be replaced as a rule. Sometimes it is possible to recondition them by using valve-grinding compound, but it is difficult to restore the original mating surfaces.

Drainable valves: Valves, which are provided with a small drain outlet in the body to allow water in the nonpressure side of the line to be drained out when the valve is closed, are called drainable or stop-and-waste valves. Gate, globe and plug valves can be of this type. Detail C of Fig. 8 shows a drainable plug valve. To determine which port should face the line pressure, you blow into both ports as shown in detail D while the valve is closed and the drain outlet is open. The port through which air flows is the one to connect to the line requiring drainage.

Installing valves: Be sure to cut pipe threads to the correct length (so the pipe end comes to the edge of the die). If the threaded end is too long, the pipe can be forced against the diaphragm or seat of a valve, which may distort it. Avoid excess pipe dope and don't put it on the internal threads of a valve. Support pipe adequately to prevent strain on valves, especially small ones. Before installing a valve be sure that the pipe has been cleaned thoroughly of chips caused by threading and reaming, and also of other foreign matter. This may lodge on the valve seat and cause trouble. Open the valve and clean it out thoroughly by flushing with water. After cleaning, close the valve and then install it. Use a flat-jaw wrench that fits the hexagon parts.



A. W. Cash Valve Mfg. Co. photos



10

Valve maintenance: A very slight leakage of water, especially hot water, across the seat of a valve wears tiny grooves in it. This is known as "wire-drawing" and eventually damages a valve beyond repair. When a valve cannot be closed tightly by hand, don't use a wrench or apply any other form of leverage to force it tighter as this may ruin it. Inspect valves periodically. When a valve is shut and water continues to trickle from an outlet under its control, the valve leaks. The remedy depends on its type and condition.

When water leaks from the stem or spindle, the packing must be replaced. To do this, loosen the packing nut, lift up the gland, remove the old packing and replace it. Use graphited asbestos packing. The split-ring type of correct size is most convenient but a few turns of the stranded type of wicking also is effective. When replacing the packing nut don't turn it too tight; just tight enough so that the packing will stop leakage. Some valves have a "back seat" which allows them to be opened fully when repacking the stuffing box. Others require turning off the water.

Safety-relief valves for water heaters: A safety-relief valve on a hot-water tank opens to let out water at a predetermined pressure and temperature below the danger point. There are two basic types of relief valves: the pop-type valve, and the diaphragm-type valve. Both are shown in details A and B of Fig. 9. Both kinds are spring-loaded, and are either preset by the manufacturer to release at a certain pressure or are adjustable to various pressures like the one shown in detail A, which also has a visual pressure scale that can be turned to any convenient position. Both types of valves are obtainable with fusible plugs which melt at a temperature of 210 or 212 deg. F., allowing hot water to escape and cold water to enter the tank, until the water is shut off and another plug inserted. A fusible plug in the side of the valve, as shown in detail A, can be replaced without unscrewing the valve, which is necessary when replacing a plug fitted on the end of a stem as shown in detail B. The latter kind, however, are more critical. The need of replacing a fusible plug calls definite attention to a possible disorder.

Another type of relief valve, shown in detail C, is opened and closed automatically by either pressure or temperature. In addition to a spring-loaded pressure release, this type has a thermostatic bellows, to which a short or long stem is connected. It comes either with or without a test lever. Such valves with short stems are used for ordinary water heaters and those having long stems are recommended for electric heaters and insulated tanks.

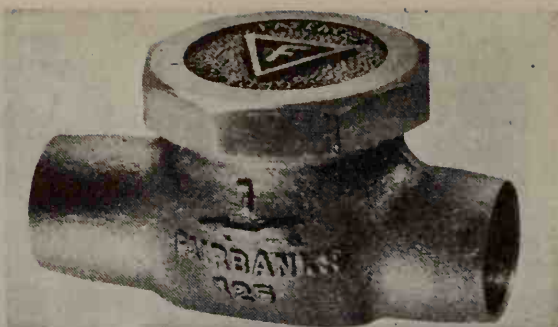
A valve that relieves pressure only, and is not provided with a temperature-actuated relief feature, may stick and fail to function when necessary. It is also desirable to have a relief valve fitted with a test lever used occasionally to check the working condition of the valve. Selection of a re-

relief valve must be made so that it conforms to local code requirements. A relief valve should be installed at the point of maximum water temperature, not more than 3 in. from the tank. It is installed usually with a T-fitting at the hot-water connection to the tank but it may be located at other positions. See Fig. 10. No other valve should be placed between the relief valve and the tank. Relief valves are especially important on "closed" water systems—those fitted with check valves or pressure-reducing valves.

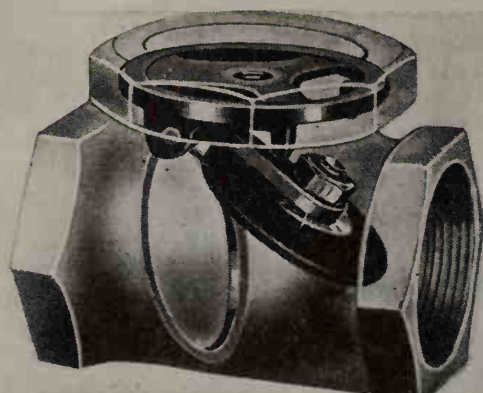
Pressure-reducing valves: Wherever water pressure exceeds 80 or 90 p.s.i., a pressure-reducing and regulating valve should be installed in the water line near the meter and in an accessible position. Its purpose is to minimize or eliminate "water hammer," which causes annoying noise and also subjects pipes, valves, faucets and even fixtures to severe strains which may damage them. Detail D of Fig. 9 shows a cutaway view of one type of pressure regulator designed for domestic use. Standard factory practice is to preset such valves to maintain a uniform outlet pressure of about 45 p.s.i., but other reduced pressure settings are available. Specifications necessary for selecting the right size of valve are maximum inlet pressure, required delivery pressure and capacity of the water system in gal. or cu. ft. per minute. Seats of these valves usually are renewable, and some types are provided with a strainer in the inlet side, which requires occasional cleaning. Whenever a pressure regulator is used it is essential to provide a pressure-relief valve on the low-pressure side of the line, as accomplished with a safety-relief valve on a water heater.

Check valves: Fig. 11 shows a solder-end, swing-type check valve and Fig. 12 shows the inside of a similar valve having pipe-thread ends. A check valve operates automatically, permitting flow in one direction only. Sometimes a check valve is combined with a throttling or shut-off valve. Some localities require a check valve in a cold-water line between the water heater and the meter. Also, check valves are used to prevent water pumped to an overhead tank from flowing back when the pump stops. Some check valves are designed for use on vertical pipes only; others are for horizontal pipes only. Therefore correct installation is essential. The closing device—disk, ball or clapper—should fall shut by gravity.

Swing-type check valves generally used in horizontal water-supply lines are installed so that the small projections on the outside of the body will be nearest the pressure side of the line; the cap that closes the body should face up. If a composition washer is used on the disk, it can be renewed

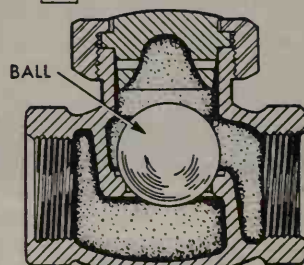


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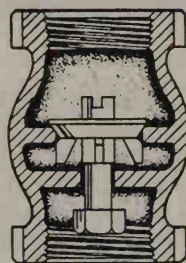


Fairbanks Co. photos

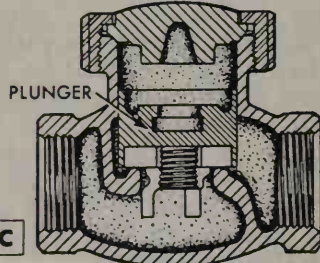
12



B FOR HORIZONTAL PIPES ONLY

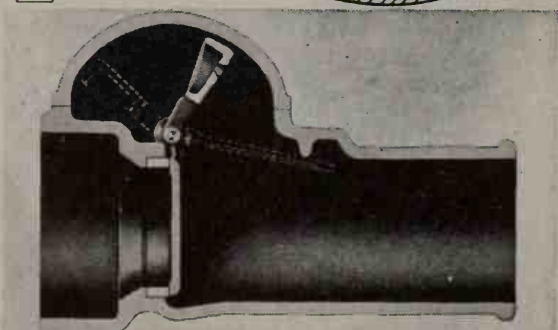


A FOR VERTICAL PIPES ONLY



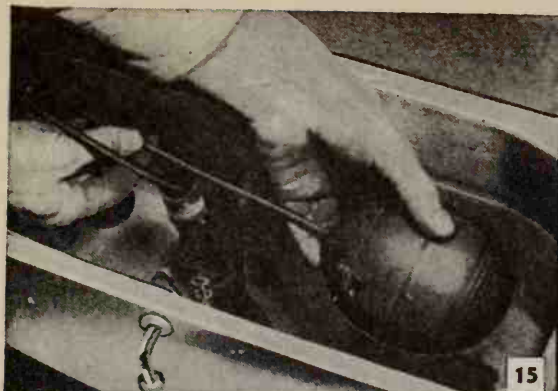
C

13

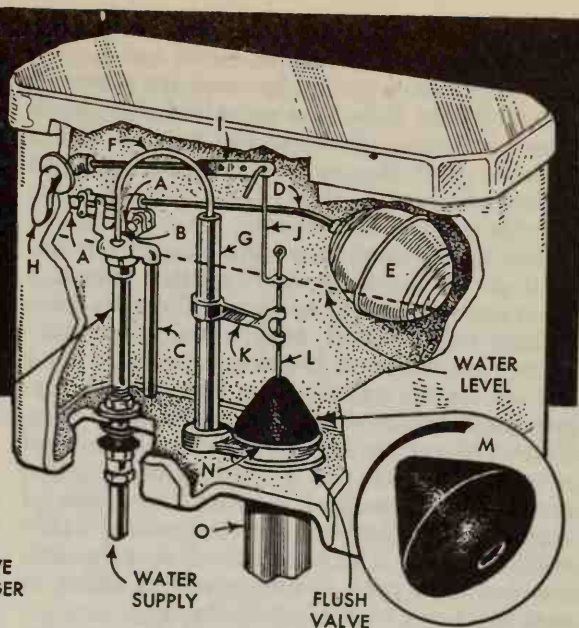
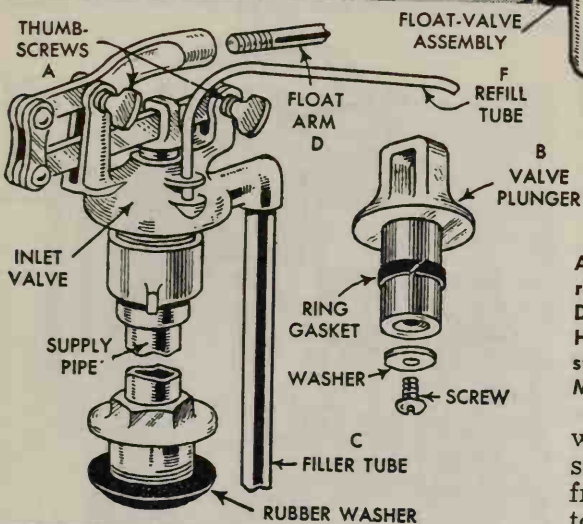


Kennedy Valve Mfg. Co. photo

14



15

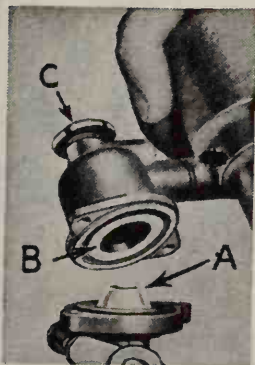
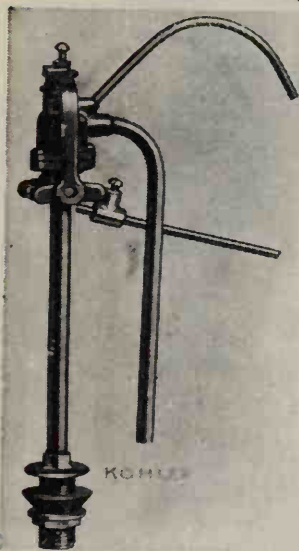


Above and at the left: A, pins or thumbscrews to release valve plunger; B, valve plunger; C, filler tube; D, float arm; E, float; F, refill tube; G, overflow pipe; H, trip-lever handle; I, trip lever to release rubber stopper; J and L, stopper wires; K, stopper guide; M, stopper; N, flush-valve seat; O, discharge pipe

water," or "backflow," valve. These are installed in house drains to prevent sewage from backing up into them. Information as to location and method of installation is contained in Section 7.

Valves on tank-type water closets: Fig. 15 shows a water-closet flush tank which functions by means of two valves. One is a float-controlled valve (float valve) through which water enters. The other is the discharge valve. Different makes vary in detail but the operating principles are similar. When the float E is raised to a predetermined level, the valve closes. On some types an adjustment screw controls float height, which is preferable to bending float-arm D, necessary in other types. When water continues to run into overflow pipe G, the float valve is not fully closed or else it leaks. Reason for not closing may be that the float rubs against the tank wall or contains some water caused by pinhole leaks. Check the valve action by raising the float arm to shut it. If water still escapes, the valve is leaky.

The usual repair consists of renewing the washer on plunger B, which is removed by loosening thumbscrews A, after turning off the water supply. The washer may be different from the one illustrated, or it may be a disk held by a brass ring. Sometimes the valve seat can be refaced, using the same method as for faucets. If reconditioning the valve does not stop leakage, replace it. Float valves come in either short or long lengths. Sometimes the threaded tailpiece,



16

when leakage develops. On valves not so equipped it may be necessary to replace the valve. On lift-type check valves, details A, B and C of Fig. 13, the line pressure should be under the seat. When leaky, these valves can sometimes be reground like globe valves. Others require renewal of the disk and seat, or must be replaced entirely. Fig. 14 shows a swing-type check valve of much larger size—called a "back-

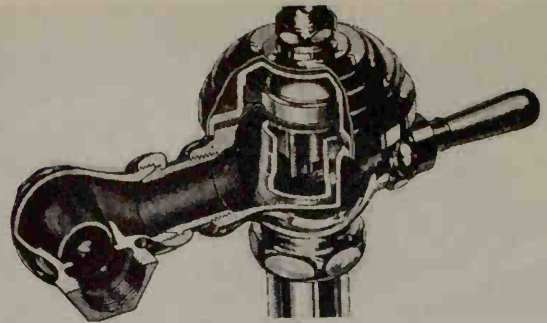
held in place on the tank bottom with lock-nuts and rubber washers, need not be removed if the supply pipe can be screwed into it. Filler tube C, also called the "hush tube," extends almost to the bottom of the tank so that the end will be submerged while refilling the tank. This reduces noise by eliminating splashing.

The water level in a tank should not extend above the float valve as this causes a cross connection. It is always best to have a float valve fitted with a backflow preventer or vacuum breaker. As little as 4 gal. of water will flush a bowl generally, but most tanks discharge more than this. Excess water serves no useful purpose and is merely wasted. If the water level is too high, adjust the float. Saving 2 or 3 qts. of water at each flushing means a considerable total in a year. The refill tube F empties into the overflow pipe G and supplies water to seal the bowl trap after flushing.

Leakage from tank to bowl through the discharge valve is quite frequent. This may be caused by grit on the plastic or rubber stopper M, by its being worn, by not seating properly, or by grit or corrosion on the stopper seat N. Improper seating may result if stopper guide K, clamped to overflow pipe G, is not concentric with the stopper seat. Wire L, which screws to a stopper, should project about 1 in. through the eye on the end of wire J, which connects to the trip lever I. If this alignment and the action of stopper seem to be correct, remove the stopper by unscrewing it from the wire, and clean the rounded surface. Also dry valve seat N and clean it with fine emery cloth. If the valve still continues to leak, substitute a new stopper. Usually stoppers require replacement every few years. If the valve seat is badly corroded, replace the seat and overflow unit.

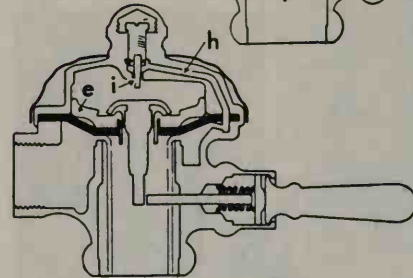
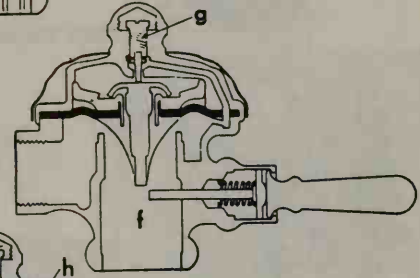
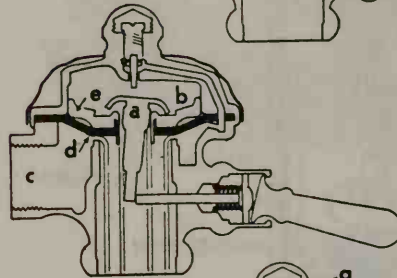
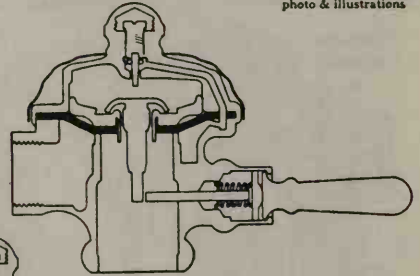
The type of float valve shown in Fig. 16 is designed to give quiet action. Valve seat A is vitreous china, which resists the corrosive effects of water. Adjustment C controls flow at B for minimum noise.

Flush valves on water closets: Flush-valve operated water closets are connected



17

Imperial Brass Mfg. Co.
photo & illustrations

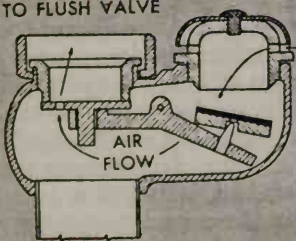


18

National Bureau of Standards illustrations

19

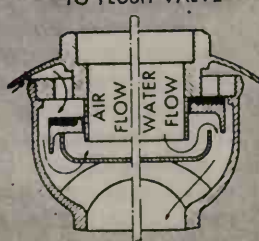
TO FLUSH VALVE



TO WATER CLOSET

A MOVING PART

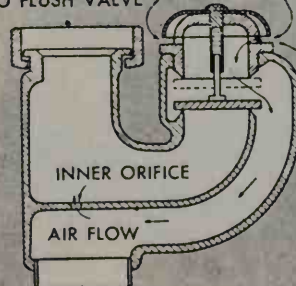
TO FLUSH VALVE



TO WATER CLOSET

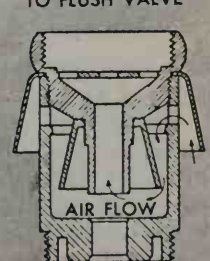
B MOVING PART

TO FLUSH VALVE OUTER ORIFICE

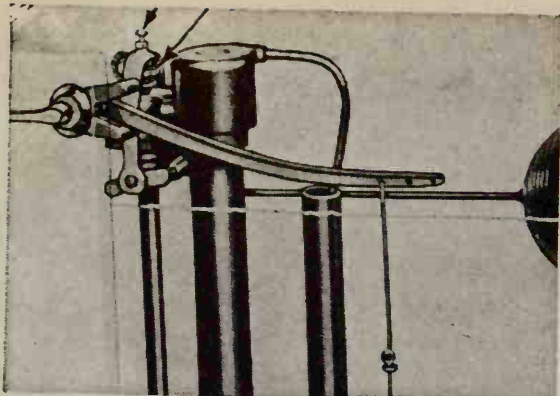


TO WATER CLOSET
MOVING PART

TO FLUSH VALVE

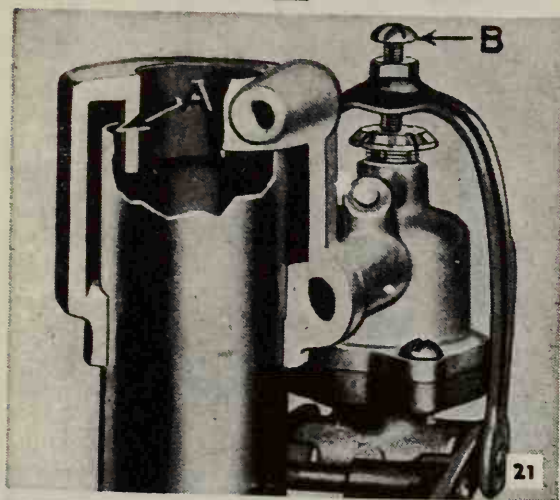


TO WATER CLOSET
NONMOVING PART

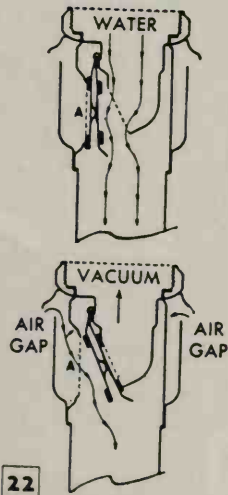
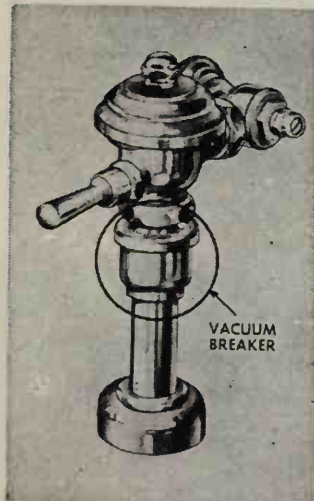


20

Kohler Co. photos



21



22

Imperial Brass Mfg. Co. photo

directly to the water-supply line, which generally should not be less than 1 in., although $\frac{3}{4}$ -in. pipe may be satisfactory for unusually high pressures. Flush valves require from 10 to 20 lbs. per sq. in. (p.s.i.) pressure. This varies with units due to the differences in design. The discharge capacity also varies with design from 20 to 40 g.p.m. but the duration of discharge is so short that the total volume of water used is less than that discharged by a tank-type

water closet. The rate of flow on flush valves is often adjustable.

Flush valves use less water than flush tanks and can be operated at intervals of only a few seconds. They also take less space and generally require less servicing than the mechanism in a tank-type water closet. There are several types of flush valves, including the diaphragm, piston and plunger types. Fig. 17 shows a cutaway view of a diaphragm-type flush valve. The four views of Fig. 18 show how it operates. At the start of a flush, the handle tilts valve "a," relieving pressure in upper chamber "b," and allowing water pressure in supply pipe "c" to exert force upwards on diaphragm "d," raising main unit "e" so that maximum flow of water passes through outlet "f." Raised valve "a" pressing against the plunger on regulating screw "g," widens opening "i" to momentarily increase flow of water through bypass "h," cleaning it and filling chamber, which forces main unit down to starting position.

Backflow preventers: Fig. 19 shows four types of backflow preventers or vacuum breakers. Those in details A, B and C have moving parts, while the one in detail D has nonmoving parts. Backflow preventers are used where it is not possible to have an air gap between the water-supply outlet and the flood-level rim of a fixture. This is more fully explained in Section 13. A backflow preventer is placed between a control valve and the fixture. Moving parts, such as a pivoted or sliding disk, are permitted on acceptable types of backflow preventers, but they cannot include springs or other elastic or flexible parts.

The backflow preventer shown in Figs. 20 and 21 is an atmospheric type and is combined with a water-closet float valve. "A" indicates where air enters and "B" is the adjustment screw to vary height of float valve so the water level will be 1 in. below the top of the overflow tube. All flush-valve water closets should be equipped with backflow preventers installed as in Fig. 22, which also shows the working principle of this design.

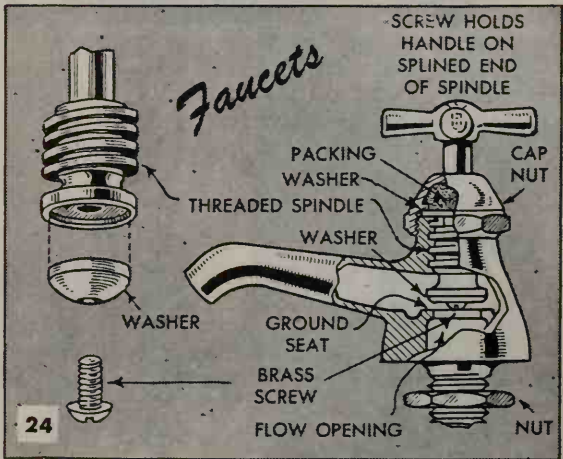
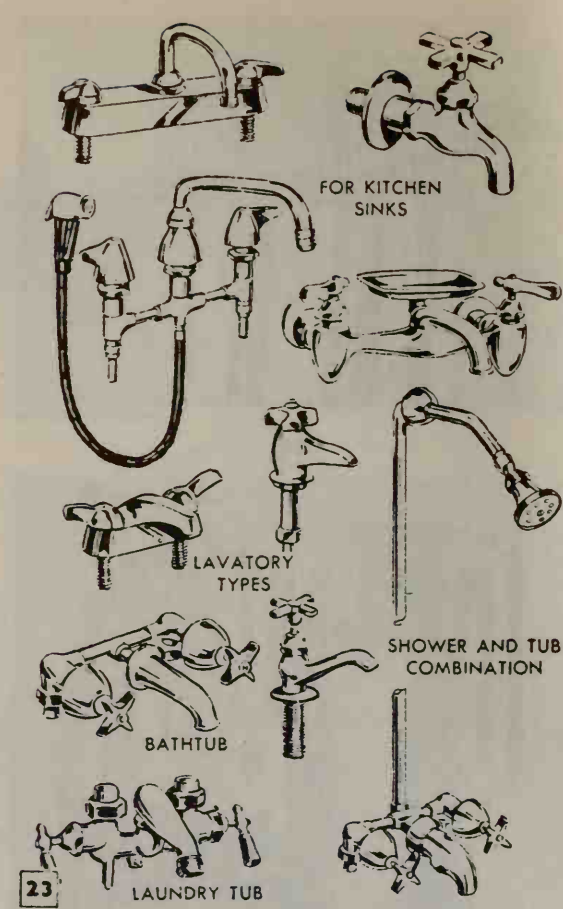
Compression faucets and sill cocks: Various styles of single and combination faucets are shown in Fig. 23. Some are connected to a common spout. Practically all modern faucets are of the compression type. Fig. 24 shows the working parts of a faucet. Notice its similarity to a globe valve. A drilled partition forms a seat against which a composition washer is brought down by a threaded spindle.

Continued dripping of water after a faucet has been tightly closed by hand, usually indicates a worn washer. To repair it first shut off the water supply. Then loosen the cap nut on the faucet with a flat-jaw

wrench. Protect the chrome or nickel finish from being marred by inserting a strip of cardboard between the nut and the wrench jaws. If the cap nut is round and the edges are grooved, use a strap wrench. After loosening the cap nut, turn the faucet handle in counter-clockwise direction so that the threaded spindle unscrews. Then you can lift out the spindle assembly as in detail A of Fig. 25. It may be necessary also to turn the faucet handle at the same time to provide clearance for the nut. Next, loosen the brass screw that holds the old washer on the end of the spindle, detail B. Sometimes the screw is corroded and is so tight that it will not loosen readily. An application of penetrating oil may help. If the screw breaks off, it usually can be removed by drilling a small hole in the remaining threaded portion, and turning out the remaining shell of the screw with the tang end of a small file. If necessary, scrape away all traces of the old washer. To determine the size of a new one, measure the diameter of the recess in which it fits as in detail C. It is sometimes necessary to dress the outside edge of a washer with a file to make it slip into the washer holder.

With the new washer in place, turn the spindle into the faucet and then screw the cap nut down. If necessary, the faucet handle can be shifted as in detail D after removing the screw holding it. Some faucets, however, have handles that cannot be removed from the spindles. For example, there is one in which the spindle works in a sleeve which is lifted out with the spindle. The spindle washer moves upward against the bottom of the sleeve when closing. Replacement of the washer is practically the same, except that a nut holds the washer instead of a screw.

Refacing faucet seats: If the flat surface of the faucet seat against which the washer compresses is rough, it will be impossible to prevent recurring leaks by merely installing new washers. Such roughness is caused by corrosion or by abrasion due to sand and grit particles becoming embedded in the washer. The roughened seat should



25



A Lift out the spindle



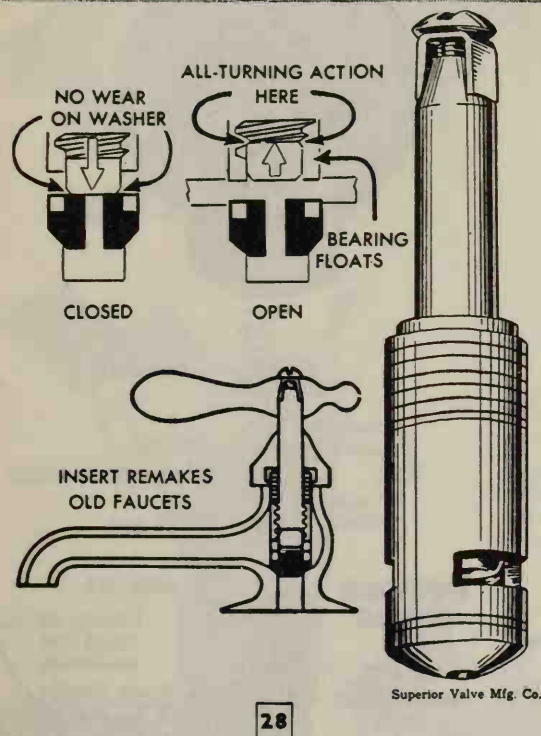
B Remove the washer



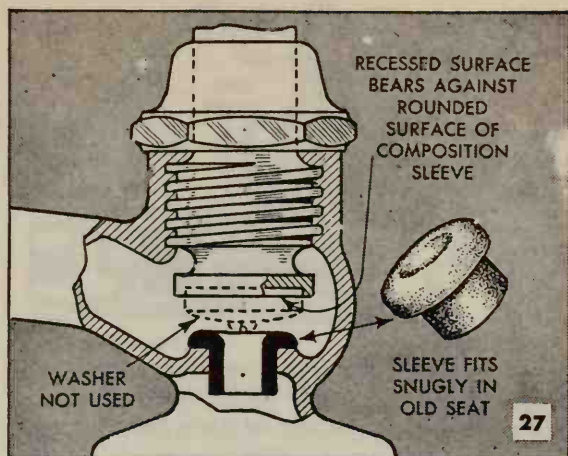
C Measure washer size



D Adjust faucet handle



be refaced by means of the tool shown in Fig. 26. Care must be taken to hold the refacing tool vertically and to use light pressure. After refacing the seat, see that all bits of metal are flushed away before replacing the faucet spindle. Another method of providing a new seat, which eliminates the cost of a refacing tool, is to use a special composition sleeve that is pressed

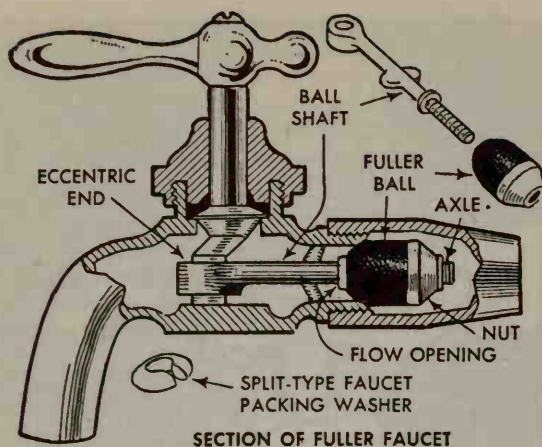


inside the old seat as in Fig. 27. The washer and screw are removed permanently from the end of the spindle, which then bears against the sleeve insert when the faucet is closed.

The process of reseating or refacing leaky faucets or replacing old faucets can be avoided generally by using a faucet insert of the kind shown in Fig. 28. When this insert is used it is not necessary to remove the faucet from the pipe. It provides a new stem, new seat and new threads. It has a nonturn compression shut-off (floating bronze bearing), which is held tightly against a rubber washer by the threaded spindle when the faucet is turned off. Turning the faucet on permits water pressure to force the bearing up. The washer is held in the end of the shell of the unit and does not rotate. The lower surface of the washer is held tightly against the faucet seat by the pressure exerted by the cap nut on the upper end of the shell. As the bearing simply presses down against the washer there is no rotary movement that causes the washer to wear. Water passes through two ports in the shell when the bearing is raised. The insert fits nearly all faucets. To install one, the cap nut of the faucet is unscrewed, the old faucet stem is removed, the insert put in place and the cap nut and handle are replaced.

Leaky spindle: Leaks sometimes develop between the spindle and the cap nut of a faucet. If tightening of the cap nut does not stop the leak, loosen the nut, slip it up against the handle and replace the packing. Sometimes it is necessary to remove the nut from the spindle entirely in order to remove the old packing. You can use a packing washer of correct size, or stranded graphite-asbestos wicking, which is wrapped around the spindle as in Fig. 29.

Repairing Fuller faucets: Although practically obsolete, there are still many Fuller faucets in older homes. On this type, shown in Fig. 30, the handle can be swung in either direction to open or close the faucet. A hor-

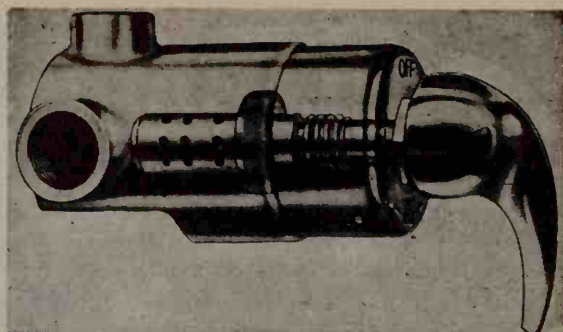


30

horizontal spindle with an acorn-shaped rubber stopper or ball (Fuller ball) at one end is moved back and forth by means of a crank-shaped vertical spindle to which the handle is attached. The entire faucet must be removed when the ball is adjusted or replaced. The sleeve enclosing the ball is unscrewed if the nut that holds the ball cannot be reached with a long-nose pliers. Turning the nut to bring the ball closer to the seat may stop the leak, or a new ball may be required. A worn spindle or ball shaft can be replaced at small cost.

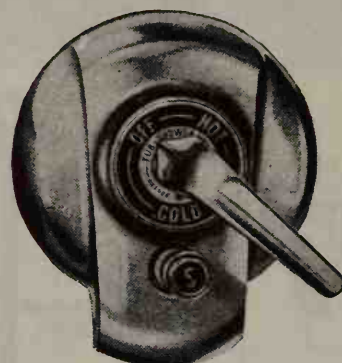
Mixing faucets: Combination faucets to mix hot and cold water are in common use for kitchen sinks, lavatories, laundry tubs, bathtubs and showers. They cannot be depended on to keep the water at a uniform temperature. For example, when water is drawn from another outlet while a shower is being used, the temperature of the shower water may fluctuate widely because of the reduced pressure. This may result in an extremely cold or in a scalding mixture, with possible serious consequences.

Automatic mixing valves for showers: Temperature of shower water can be maintained within a few degrees even when there are pressure drops of as much as 90 percent in either hot or cold-water line. This is accomplished by means of a pressure-controlled mixing valve such as shown in Fig. 31. Fig. 32 shows the exposed portion of a slightly different model having a control valve that directs water to either shower or bath. The mixer consists of a cylinder containing a free-moving, pressure-equalizing piston. The latter is actuated by cold-water pressure at one end and hot-water pressure at the other, which directly controls the amount of hot and cold water admitted and so maintains the temperature of the mixed water as originally adjusted. The interior of the valve is completely accessible from the front for replacing washers or the seat unit, should this become necessary. The valve shown is

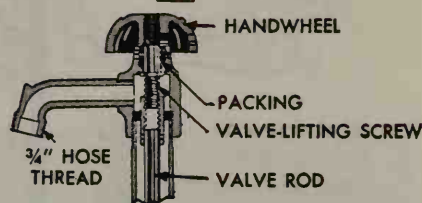


Symmons Engineering Co. photos

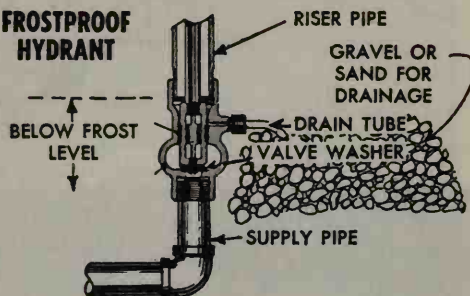
31



32



FROSTPROOF
HYDRANT



33

the concealed model with only the handle and front plate visible. Exposed models also are available. Thermostatically controlled mixing valves also are available.

Frost-proof hydrants: Where an outdoor outlet is connected to an underground supply pipe and is used the year around in localities where the outlet is likely to be damaged by frost, a frost-proof hydrant, Fig. 33, has the great advantage of being trouble-free. The valve is located below frost level and is operated by an extension rod. When closed, the valve drains off water from the riser pipe. A gravel or sand bed, as indicated, permits rapid dissipation of the drained water. Insulating the riser pipe helps to prevent ice formation inside.



Child's Coolie Hat



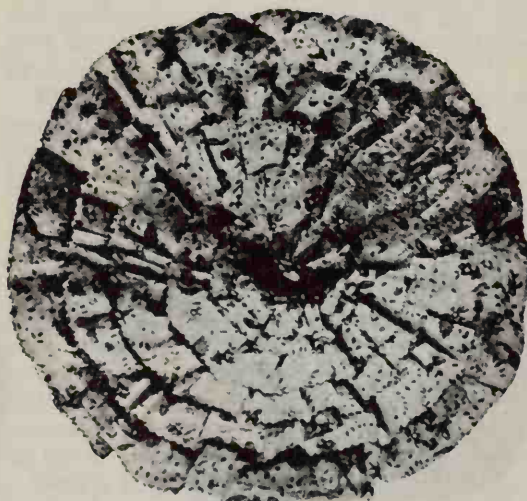
Christmas Stockings

FEED SACKS

ECONOMICAL, attractive and easy to make are these projects from cotton bags in which feed, flour and fertilizer are packaged. These bags come in a variety of colorful prints as well as in fine white cambric. The prints are suitable for making dolls, stuffed animals, bibs, aprons as well as the other projects shown on these pages. The white cotton sacks can be used for embroidered dish towels, pillow cases, place mats and luncheon sets.

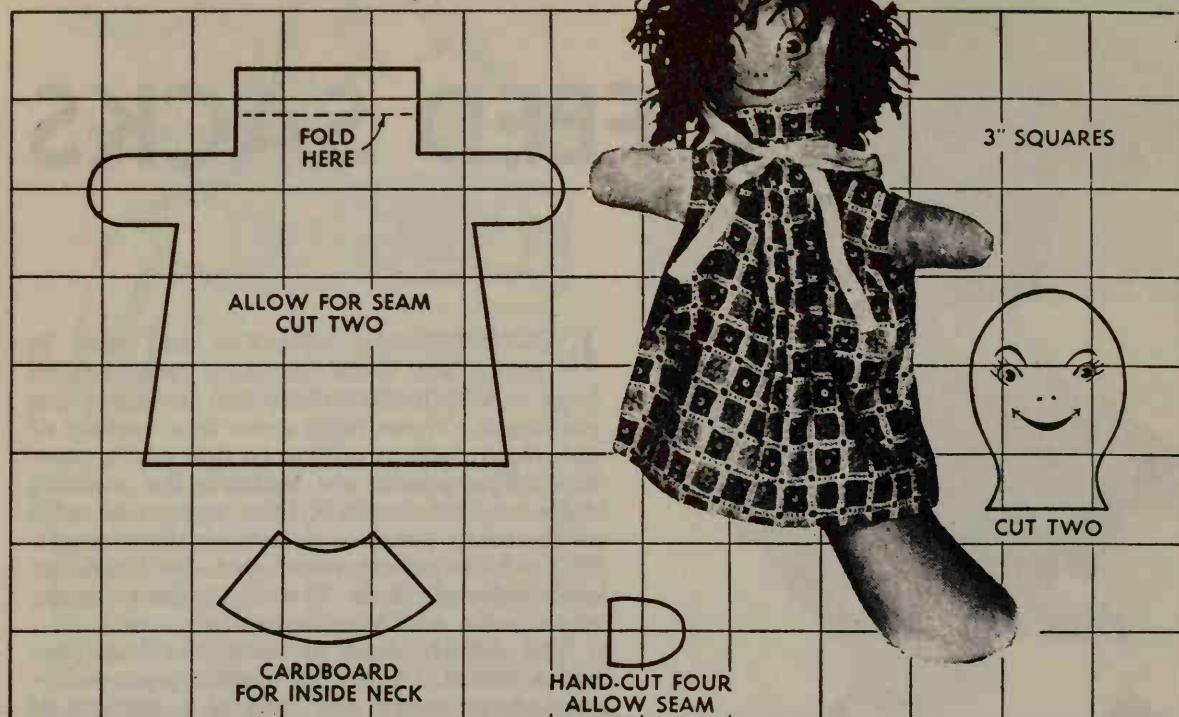
The 100-lb. feed or fertilizer bag provides about $1\frac{1}{2}$ yd. of cotton material—enough to make any one of a variety of projects. Clever items can also be made from the 25-lb. flour bags, which are available in print patterns in many city as well as country grocery stores. This bag measures 26 x 26 in. when flattened after the seams are taken out.

Preparing cotton bags for sewing is a simple process. The chain-stitched seam rips out in a jiffy when the thread is clipped in the corner. Brand labels or trade names printed in wash-out inks come off easily when the bag is soaked in water. To get you started on cotton-bag projects the following items are suggested.



Vanity-Stool Cushion,

Hand Puppet

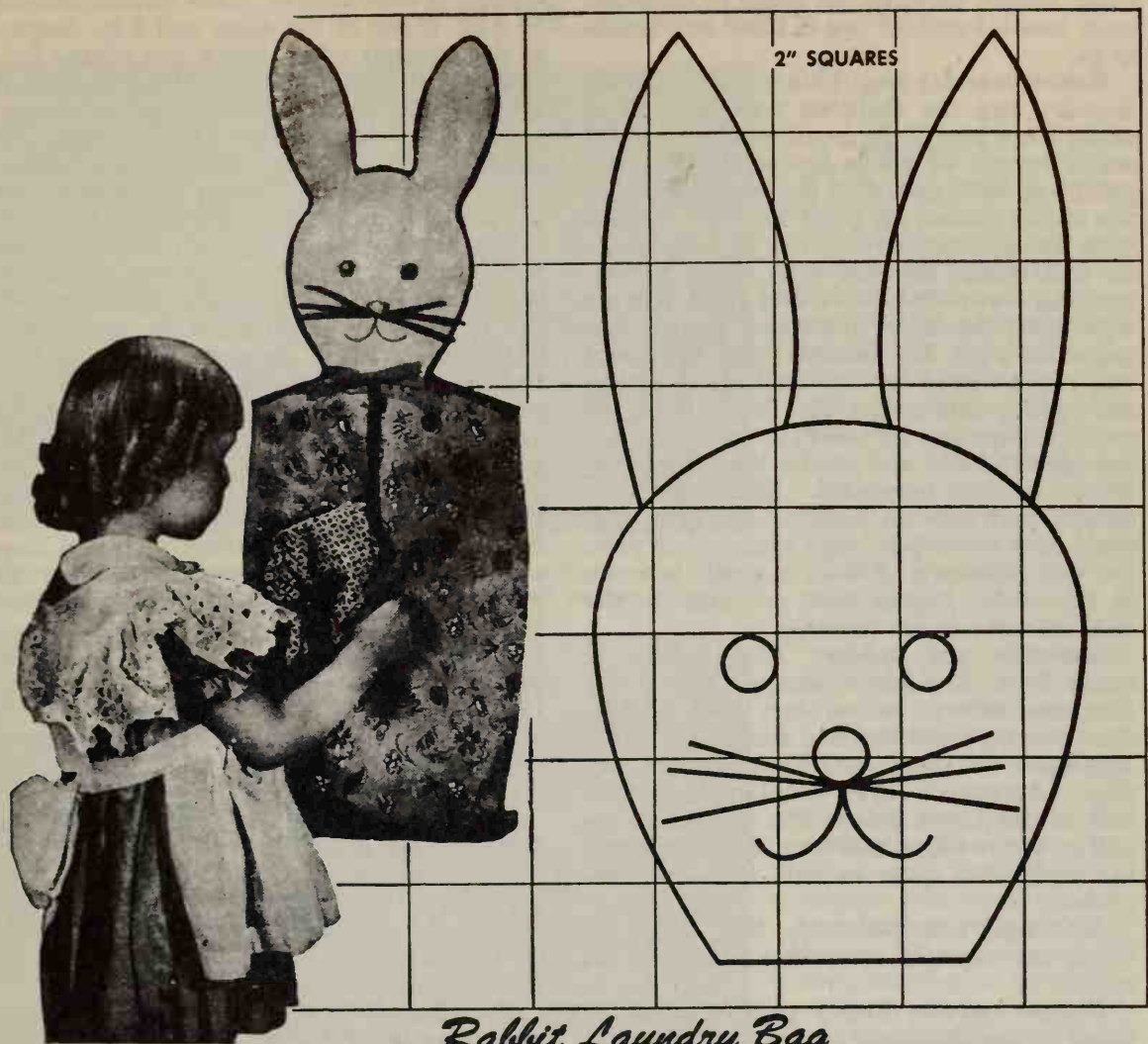


Child's coolie hat: The first step in making this hat consists in cutting two circles 14 in. in diameter. Make a 2-in. dart tapering from edge to center so that the hat will be pointed. Cut one circle, 14 in. in diameter, from cardboard. Clip from edge to center and lap to make the point. Fit the circles together over the cardboard, stretching and pinning at the edge to remove slack cloth. Next, bind the edge. Then, tack the bow made from tape at the point on top. Finally, fold a 60-in. strip of bias tape together, stitch and tack on the inside of the point for the tie.

Christmas stockings: A discarded stocking can be used for the pattern. Lay the stocking on printed or plain cotton-bag material (double thickness). Allowing plenty of room for toys, cut the material to any desired length. Sew the pieces together on the wrong side and turn inside out. Cut a cuff to fit the top of the stocking. Sew the right side of the cuff to the inside of the stocking so that the seam will be underneath the cuff. Embroider the child's name on the cuff. Add a Christmas bell and a loop for hanging the stocking.

Vanity-stool cushion: This unusual cushion





Rabbit Laundry Bag

ion combines plain white or solid material with print-bag fabric. For the cushion base, cut two circular pieces from a plain cotton bag or scraps of material. Cut and make the ruffles from a print bag. Beginning at the outside of the top circle (allowing room for a seam at the edge), sew ruffles in spiral fashion until the center is reached. Let each row cover the preceding row so that the entire surface is covered with ruffles. Tack a small ribbon bow at the center. Sew two basic circles together for the cushion, turn and stuff.

Hand puppet: Using the diagram on page 29, cut two pieces each of the head and dress. Use white or flesh-colored material for the head. Sew up the head and stuff tightly. Form a cardboard insert into a cone shape, tape securely and insert in the head. Turn the neck edge inside the cardboard cone and tack fast. Sketch the face with pen and ink or paint it on. Rouge the cheeks. Using coarse cord for hair, sew in the loops. Then cut the loops for a bushy look. Fold the dress neck as shown and stitch. Attach the hands (four pieces) to

each piece. Sew up the sides of the dress pieces. Sew in the gathering thread to pull the neck tight. Put the head in place, pull the gathering thread tight and tie. Then sew the head to the neck. Finally, tack tape around the neck and tie a bow.

Philip the frog: For the body, cut two oval pieces of cotton-bag material, 7 x 11 in. The pieces need not match in print design. Shape to a point at one end. Cut 2½-in. squares, double thickness, for the legs. Sew around, turn and stuff loosely. Pin two body pieces together wrong side out. Place one corner of each leg square in the seam from the inside. Stitch around, leaving one side open, and turn. Stuff tightly and stitch together. Cut circular pieces from felt. Sew these pieces on with glass buttons at the centers for the eyes. Philip will sit up or lie flat.

Beach bag: This colorful beach bag was made from one full-size 25-lb. flour bag. Rip the bag, line it with terry cloth and bind the edges with grosgrain ribbon, 1 in. wide. Sew five loops of ½-in.-wide ribbon across each corner of the square. Run an-

other ribbon through the loops to tie when your beach kerchief bag is filled and ready to go.

Rabbit laundry bag: This is a clever little laundry bag the children will love. It is made from one 25-lb. print-cotton bag and small scraps of plain material. Use the print bag unripped. Cut the laundry bag to the shape shown on page 30. The outside edge should measure 18 in., the center 19 in. and across the top 4 in. Split a 9-in. opening down the front and bind it with tape. Cut the head according to the diagram on page 30. Scraps from the print bag can be used for the back of the head and white fabric for the face. Print or pastel scraps can be used for the ears. Assemble the head and attach it to the body. Bind the top complete. Embroider the mouth and sew on buttons for eyes and nose. Use three 6-in. pipe cleaners or yarn for the whiskers. Attach a small bow tie at the neck. Fasten cord or rings on the back of the ears for hanging.

Butterfly pot holder: This holder is made from bag-fabric scraps. Using the diagram shown below, cut two butterflies, one body section and four wing spots. Appliqué the body and spots on the top piece. Arrange a layer of cotton on the inside of the lower piece. Pin the wings together at the edges and bind. Stitch around the body and spots to hold the cotton in place.

Although not pictured, the following items are equally attractive and easy to make.

Hanger covers: Pretty protection is offered to the shoulders of dresses, suits and coats by these hanger covers. Two of them can be made from a 50 or 100-lb. cotton bag. Each cover requires a half yard of material and 4 yd. of bias binding. Make your own pattern by drawing an outline

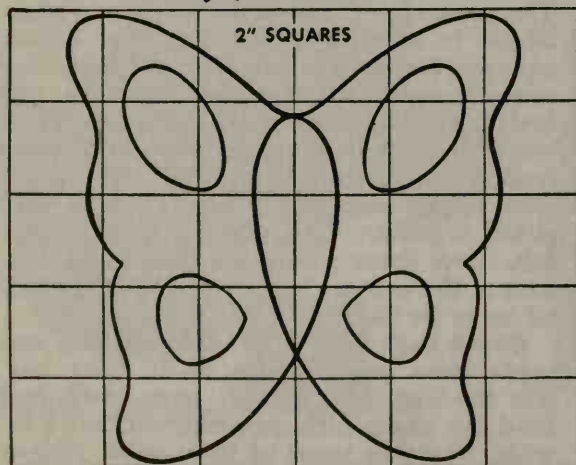
around a wire hanger. This outline should be 2 in. wider at the sides and 4 in. deeper at the straight edge. Mark the center top. Cut the pattern on the straight of double thickness of material. Two strips of material, cut 2 in. wide and 14½ in. long, are sewn to the top sides of the cover beginning at the center. Finish the seams and the lower edge of the cover with bias tape.

Lingerie cases: Brightly colored print bags may be used for these cases and white cambric bags for the lining. For contrast, the cambric may be dyed to match the dominant color in the print pattern. Cut the case and the lining the same size—17 in. wide and 28 in. long. Place the right side of the lining to the right side of the case. Baste, then stitch three sides together allowing a ½-in. seam. Turn the case right side out and slip-stitch the flap end to the lining, inserting and sewing a ribbon loop at the center. Fold the case 10 in. from the bottom and slip-stitch the sides together. Sew a small button on the lingerie case at the center. For a complete set, two other cases may be made by cutting the material 13 x 22 in. and 10 x 17 in. Follow the above directions in putting the cases together. These finished cases will be 12 x 8 in. and 9 x 6 in., respectively.

Shoe bags: These can be made from long strips of bag fabric, folded at the base and hemmed at the sides. Cut the strips long enough to allow for a hem at the top. Double drawstrings are inserted in the hem to close the bags. Bags made in plain fabric may be monogrammed.

Hose bag: To make a portable hose bag, use a coat hanger and print or plain cotton bags. Lay the hanger on the double fabric. Cut a rectangle any size you wish and shape it like the hanger at the top. Bind the edge with bias fold. Cut an opening in front and bind the edge.

Butterfly Pot Holder



FENCES

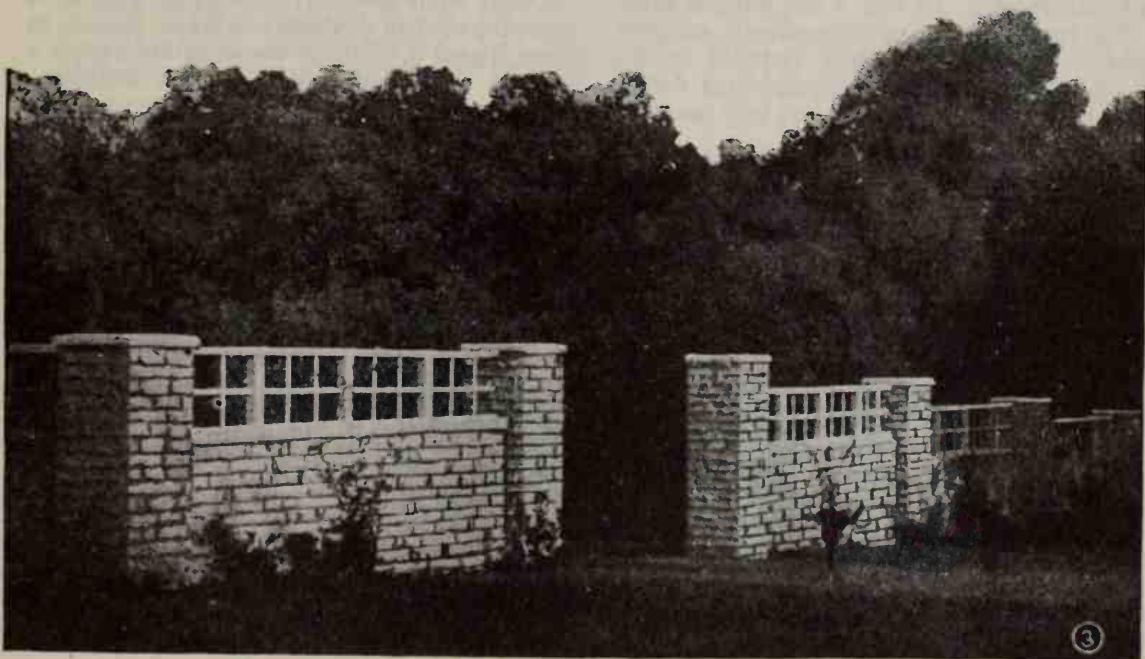


Above, this "rail" fence is made of square stock with hewn or adzed edges. Below, a low X-brace design frames a small cottage effectively



A FENCE does for the house what a frame does for a picture. It bounds the area, and just as a frame may add to or detract from a picture, so may the fence do much to improve or impair the appearance of a house. The style chosen should blend with the general architecture. To use extreme examples, a Georgian house would not look well with a split rail fence, nor would a log cabin appear natural surrounded by a brick wall. However, many of the styles shown here will blend with most types of architecture.

When building a fence, the posts should be spaced an even number of feet apart; 6, 8 or 10 feet, for example. The reason for this is that the 2 by 4-in. lumber that forms the top and bottom rails of most fences comes sawed in such lengths, or multiples of these dimensions, and can be cut without waste.





But if the design is best with the posts spaced an odd number of feet, as shown in the details of Fig. 7, a 7-ft. length can be cut from a 14-ft. piece and a 9-ft. span cut from 10-ft. stock without much waste due to the lap past the posts. Figs. 1, 2 and 3 show wide variations in the design of fencing which has been adapted to the setting. In Figs. 1 and 2 notice how the fence has been especially designed and located to complement structural details of the house in both cases. In Fig. 3 the heavy, massive architecture of the wall-and-fence combination borders a large landscaped area most effectively. In Fig. 4 the simple lines of the board fence unobtrusively supplement a landscape largely natural in its arrangement and add a foreground detail that is pleasing to the eye at any season. Moreover, the fence serves the additional dual purpose of defining the boundaries of the property and providing a back-drop detail for the low, flowering shrubs bordering the grassed area in the near foreground.

Fig. 5 shows how another fencing problem has been worked out with the architecture of the house and the boundaries of the property in mind. To break up the geometric pattern formed by the vertical and horizontal lines of both the picket

fence and the house, tops of the pickets have been cut and fitted on a radius and the regular curve thus formed is further accentuated by nailing a thin wood strip over the curved ends. The gate in this particular fence is so constructed that it forms part of the major curve, as you can see from the photo and the detail in Fig. 7. Thus the long sweep of the curved strip has the effect of lengthening the spans between the posts and makes the area enclosed appear larger and more spacious. Such a design is especially effective where the fence must be near the house, as on a small lot.

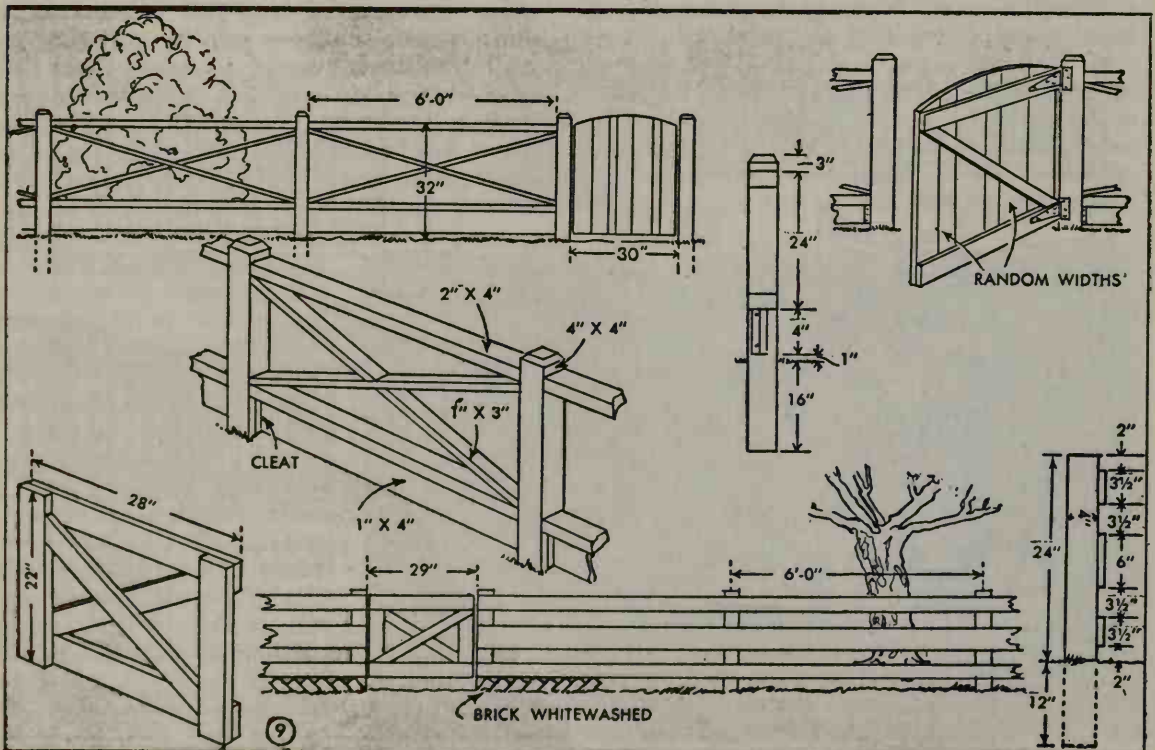
Other examples of the application of complementing designs are those shown in Figs. 6 and 8, both of these following to a certain degree the lines of the building. Both houses are of the rambling "ranch-

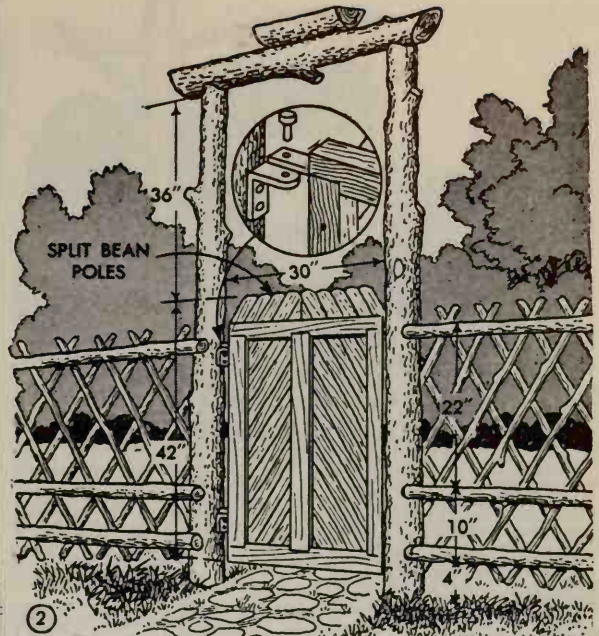




boards can be used, although those of the former grade are much more difficult to paint. In setting posts permanently first creosote the lower ends up to the ground line and then set in concrete, making sure that the lower ends project as shown in the upper center detail of Fig. 7. Fasteners, such as nails, screws, bolts, hinges and hooks, used in assembling any of the fences shown should be zinc-coated or otherwise made rust-resistant. In any case, always use coated nails as they not only resist rust for long periods but hold much better in soft woods. Unless colors are demanded by some special outdoor decorative scheme, fences are commonly painted white, using an outside lead-and-oil paint, or are stained with creosote which also acts as a preserva-

tive. The fence will be much more enduring if you take the time to apply paint to the surfaces of all joining parts. If you assemble the fence first and then paint it you leave a portion of the surfaces unprotected. Moisture works into the joints and is absorbed through the uncoated wood. This causes swelling, loosening of the nails and eventual checking and decay. The best way is to prime the wood and then apply one finish coat before assembly, but if you're in a hurry apply the priming coat to the joining surfaces as you assemble the parts. It's advisable to do this when finishing with either lead-and-oil paint or creosote. The primer should be thoroughly dry before applying a second coat, otherwise peeling is likely to result.

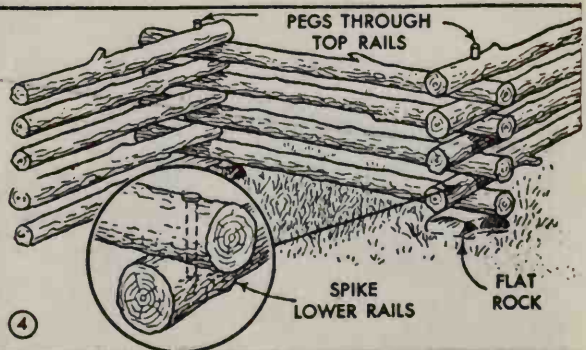
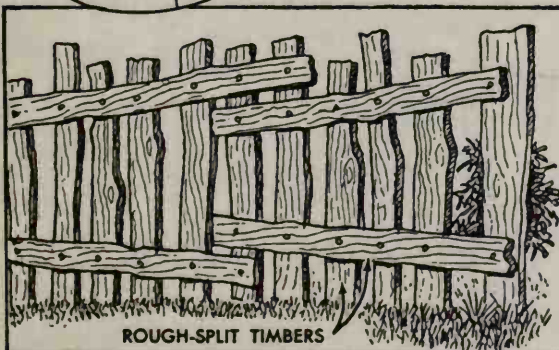
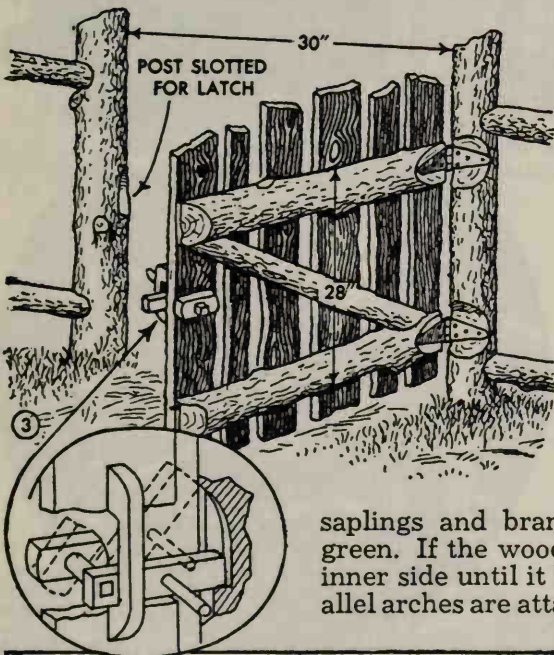


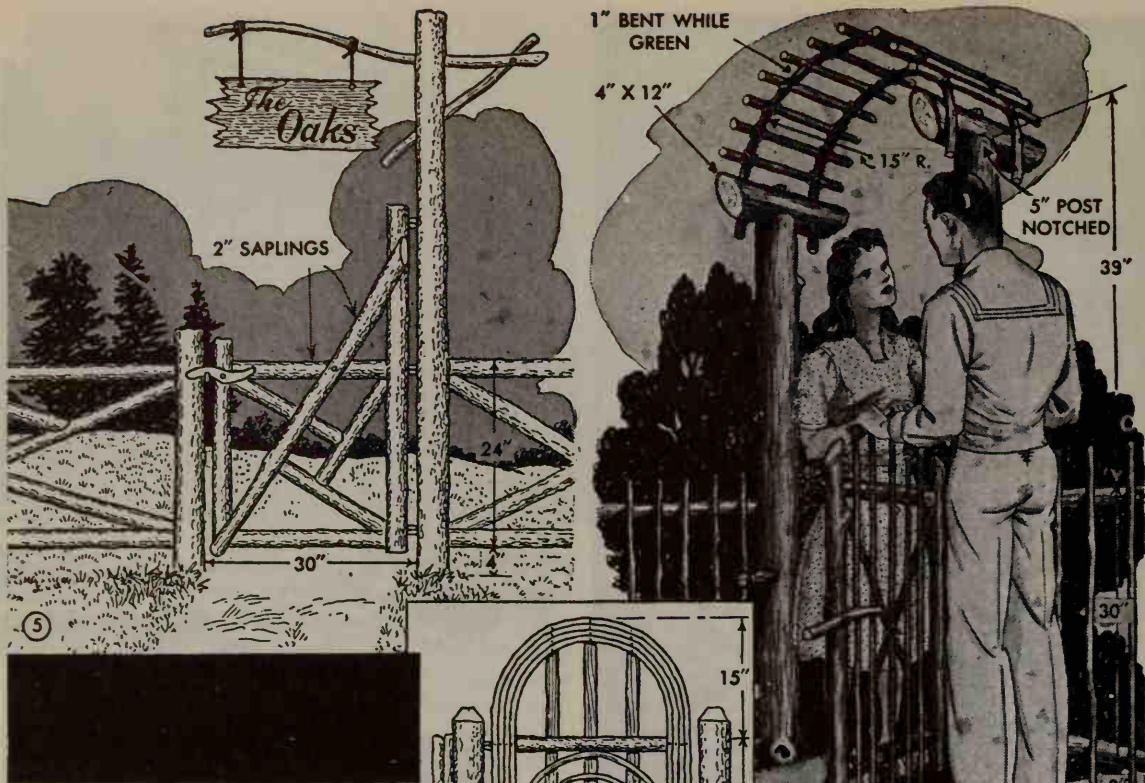


FENCES

IN BUILDING rustic structures only seasoned material should be used, except members that are to be bent to a curve. These are best handled green and should be bent around a wooden form and allowed to season before installing on the permanent frame. Bark left on the pieces adds to the interest. But if it is of the variety that peels readily when dry, it should be removed. Screws are better than nails for assembling the parts, as they can be tightened if the wood shrinks. Where posts are set into the ground the ends should be tarred or creosoted to forestall decay.

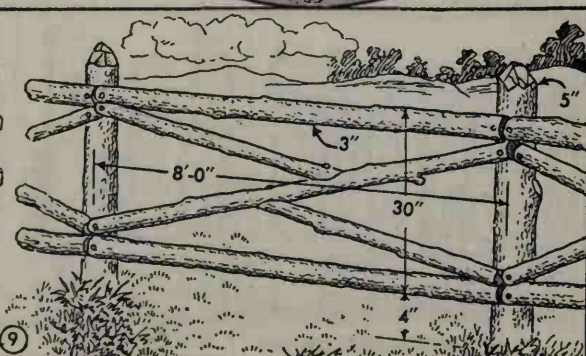
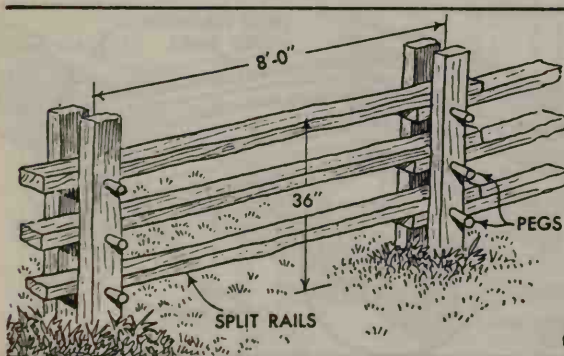
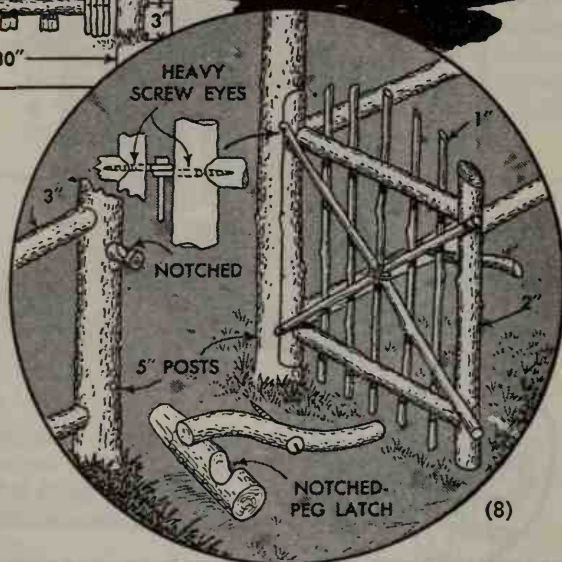
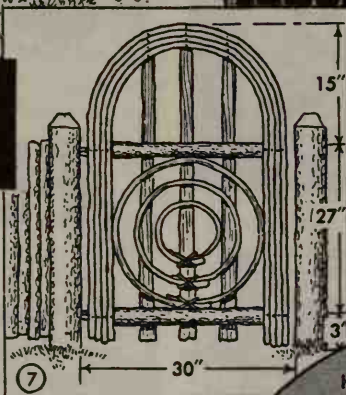
The arched gateway in Fig. 6 is built of saplings and branches, the two arched members being bent green. If the wood selected is difficult to form, shave down the inner side until it bends easily. The short pieces across the parallel arches are attached with raffia or heavy brown cord. Pickets

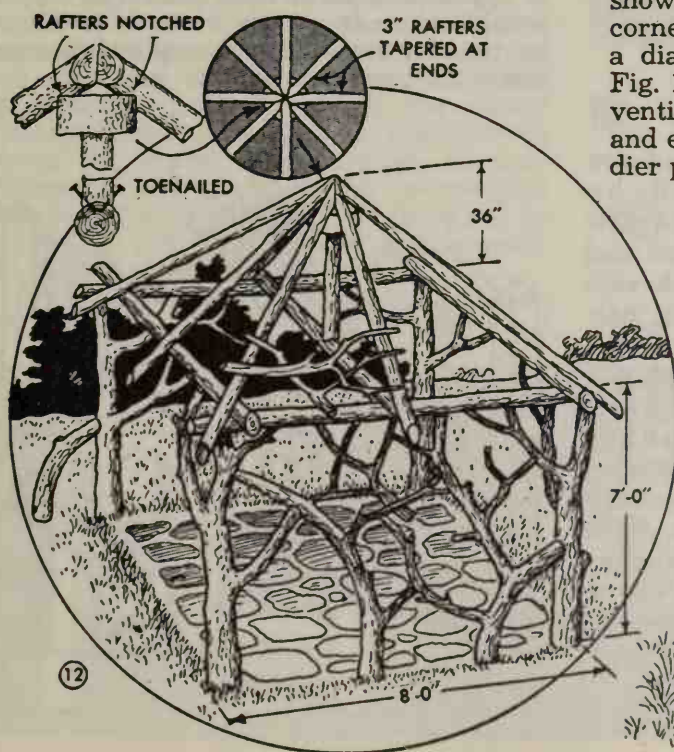
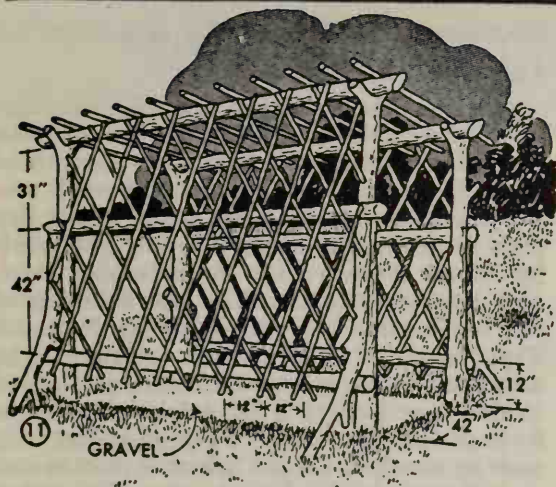
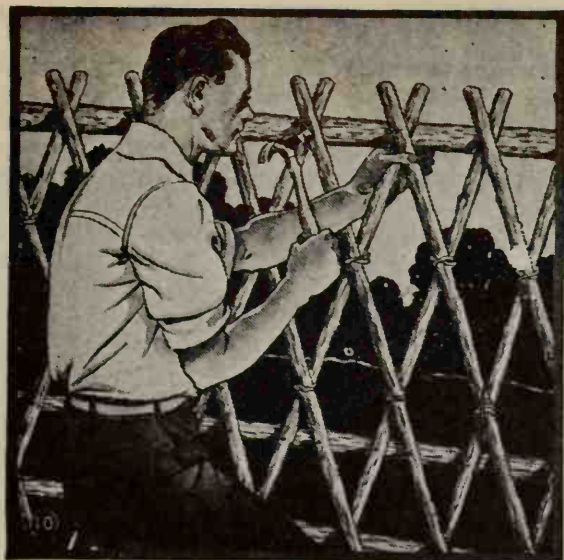




are 1-in. sticks nailed in place. If the wood tends to split, small pilot holes should be drilled. A notched peg and pivoted stick serve as a latch for the gate, which is detailed in Fig. 8. Hinges are heavy screw eyes with bolts through them.

An attractive gate suitable for a rail or slab fence is shown in Fig. 3. Rough-hewn slabs with artificial knotholes are nailed to a frame of split saplings and hung on strap hinges. A wooden latch locks in a slot in the gatepost. The herringbone gate in Fig. 2 is an easy project in localities where split stakes are available in quantity. The split members, when nailed with the flat sides against a board frame, form an attractive panel effect. Bolts through metal angle brackets serve as hinges. A commercial latch is used. The diamond-pattern fence adjoining the gate consists of sticks nailed



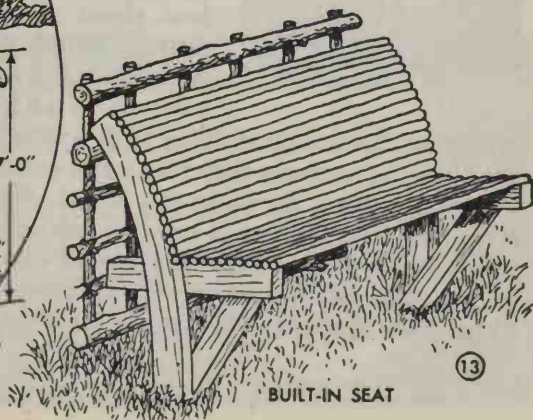


or bound to horizontal members as in Fig. 10. Other pleasing designs in gates are possible with green willow switches, the gate in Fig. 7 being a good example. The willow bends readily to a small radius and is secured to a rustic frame with brads and raffia. A more rugged type of gate, with name plate included, is presented in Fig. 5.

In sections where timber is plentiful the log fence in the right detail of Fig. 9 is a good type. Reminiscent of boyhood days on the farm, the rail or "snake fence" in the right detail of Fig. 4 is an adaptation of the original, but has no stakes at the joints. Instead, it is secured with spikes, which are driven as the rails are laid. The two top rails are held together with hardwood pegs, and each section rests on a flat rock.

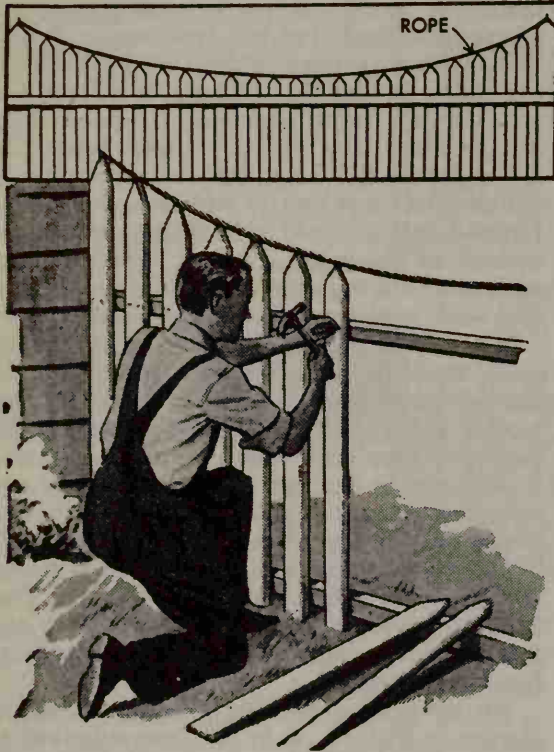
A really informal fence is made of rough-split timbers, or slabs assembled as in the left detail of Fig. 4. Discarded telephone poles split to form three-cornered rails are excellent where a ranch or farm-type fence is desired. After the posts are set, you simply lay the rails in between them, one on top of the other, as in Fig. 1. The only white-washed fence in this group is illustrated in the left detail of Fig. 9. The rails are rectangular in section and are spaced a few inches above each other on hardwood pegs.

An unusual arbor for a garden walk is shown in Fig. 11. It is built on substantial corner posts and braced at each side with a diamond-pattern trellis of light sticks. Fig. 12 shows a design for a very unconventional arbor that can be made of odds and ends from a brush pile, once the sturdier posts, plates and rafters are obtained.



Clothesline Used as Height Gauge in Building Scalloped-Top Fence

To simplify the job of marking and nailing the pickets to the crossrails of a scalloped-top fence, one man suspended a length of rope between the two end pickets of each section and used its natural curve as a guide. He first set the end pickets for height by holding a straightedge and level across the top and then drove a nail in the top end of each picket for at-

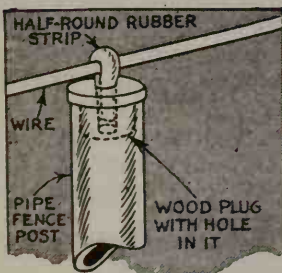


taching the rope. The rope not only served as a guide for marking the pickets for length, but was used to line up the tops of the pickets as each one was nailed to the fence rail. The same depth of scallop is maintained for each section by setting all end pickets an equal distance apart and using the same length of rope between the pickets.

Sectional Fence Can Be Dismantled To Facilitate Mowing

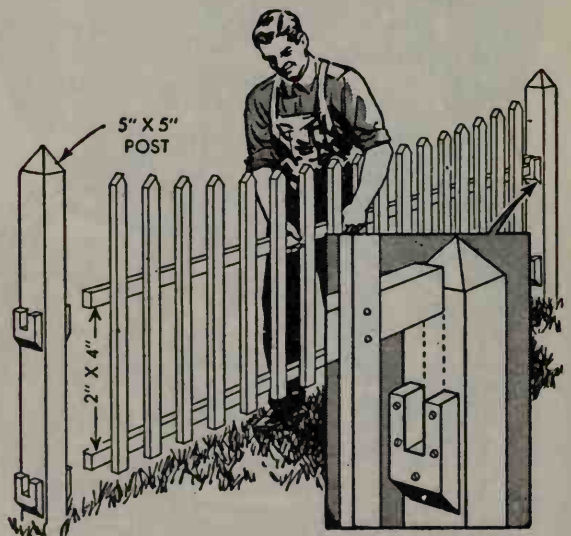
Here's a picket fence designed to overcome the tiresome job of trimming grass along the bottom of a fence. It's assembled in sections so that you can lift each one out and mow between the posts. While this still requires trimming around the posts by hand, it does save considerable time, and by being removable, the sections of the fence also are much easier to paint. The pickets in each section, which can be arranged in any pattern desired, are nailed to the face side of 2 by 4-in. rails, cut to fit between the posts. The ends of the rails rest in notched blocks which are screwed to opposite faces of each post. The notch should be made a little oversize to allow for possible swelling and ample clearance when the parts are heavily painted.

Portable Electric Fence



An electric fence which can be moved with a minimum of time and effort is made easily by using hollow pipes of the desired length and pieces of half-round rubber

stripping. Each pipe is fitted with a wooden plug having a center hole just large enough to accommodate the ends of a length of the stripping. The rubber is used as insulators and also holds the wire in place. A cap to fit the tops of the posts will prevent the plugs from splitting when posts are driven.

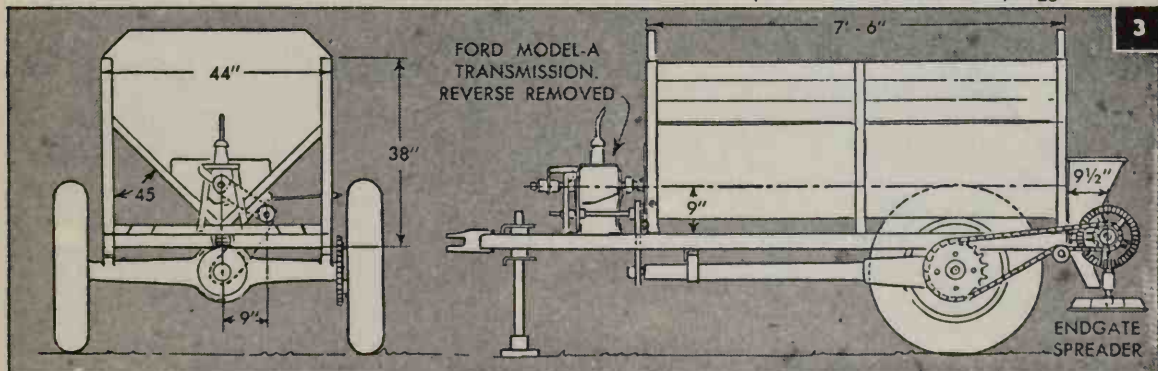
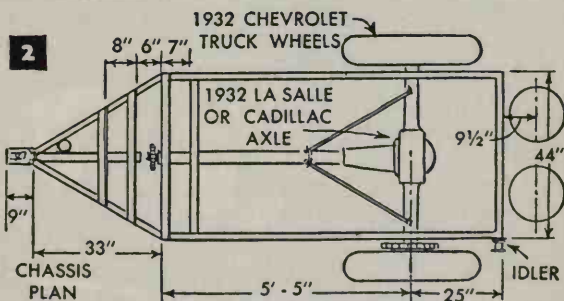
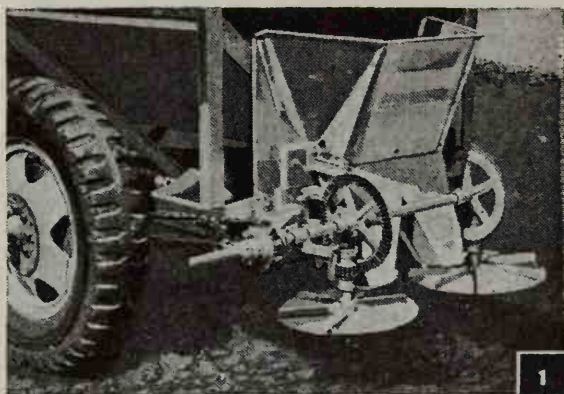


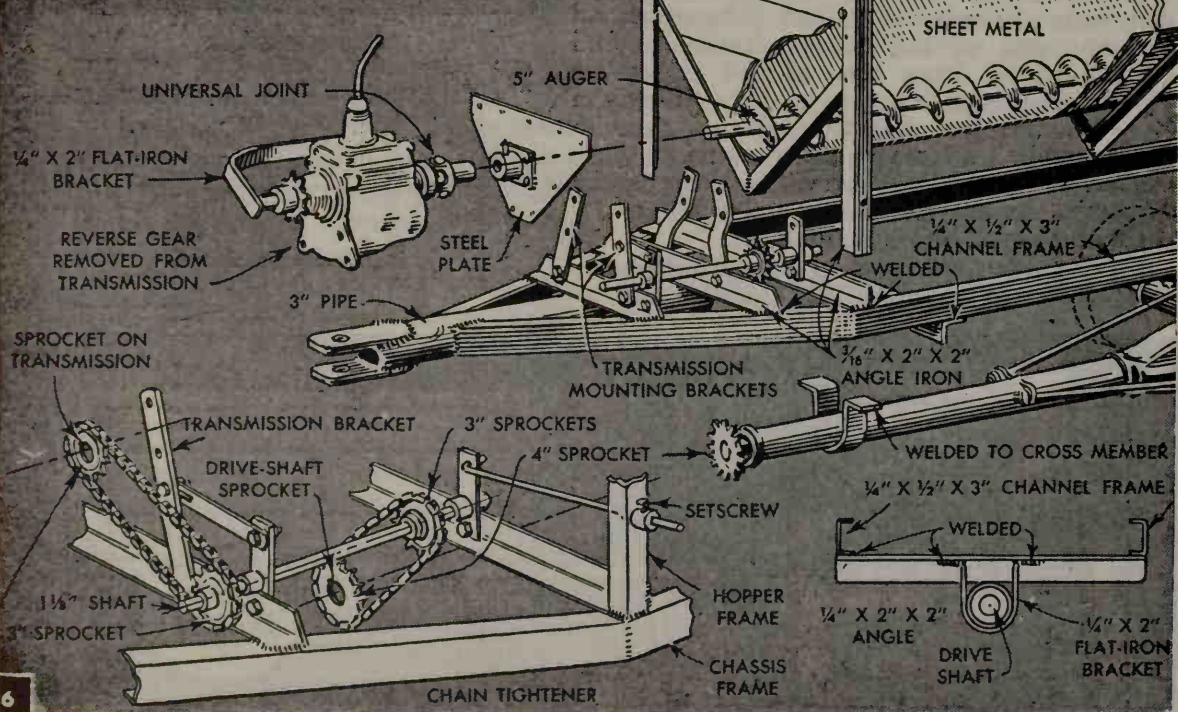
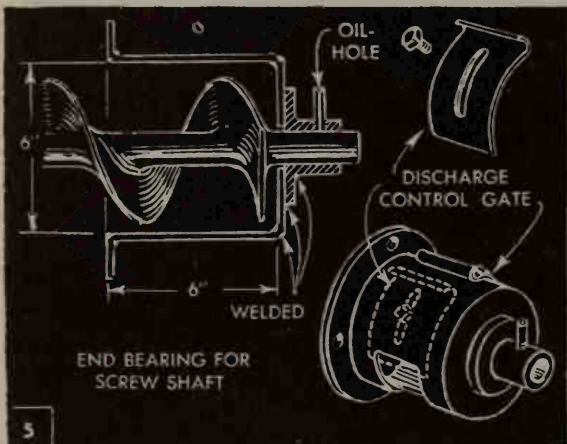
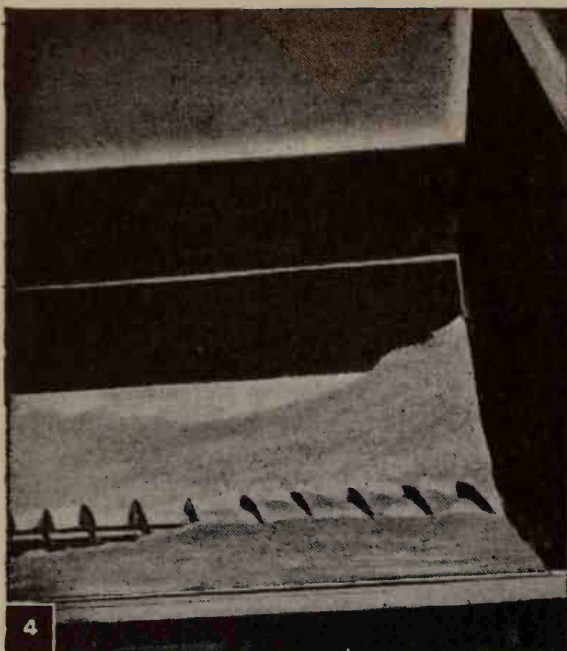
FERTILIZER SPREADER



BUILT by Viking Ramsing of Nuevo, Calif., and assembled from discarded automobile and farm-implement parts, this labor-saving spreader enables one man to apply gypsum, lime, sulphate of ammonia and other concentrated plant foods quickly and evenly at tractor speeds. It consists of a hopper of 2-ton capacity mounted on a heavy two-wheel trailer. A 5-in. materials auger in the bottom of the hopper; Fig. 4, carries the contents to an endgate-type distributor or spreader which is mounted on the rear of the trailer frame and ground-driven from one of the trailer wheels. The hopper screw is chain-driven from the trailer axle through an auto transmission from which the reverse gear has been removed. The whole thing can be towed by any small tractor and is easily maneuvered on its two wheels.

The transmission is taken from a Model-A Ford, the axle from a 1932 Cadillac and



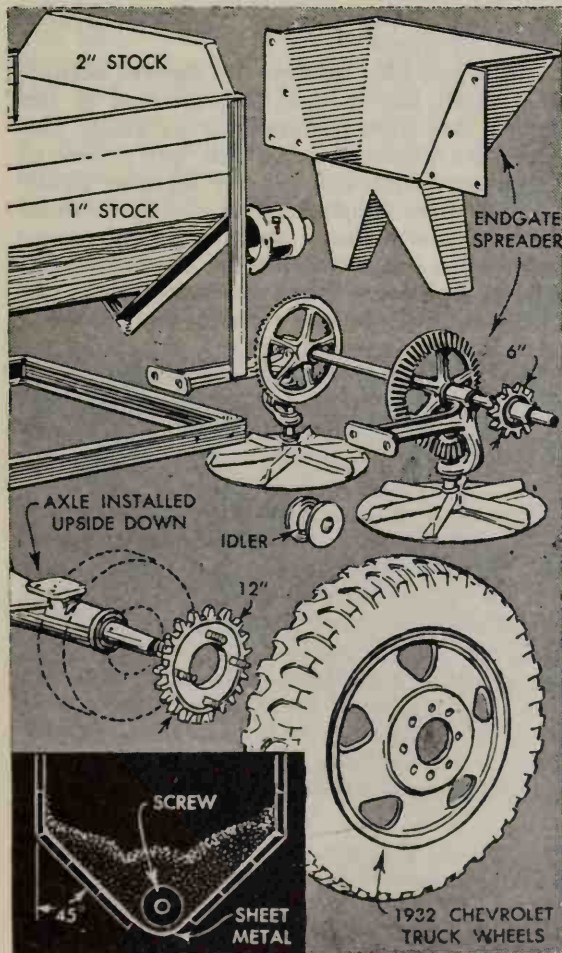


the wheels from a 1932 Chevrolet truck. The endgate distributor, Fig. 1, is a standard unit. A plan view of the chassis is shown in Fig. 2, while front and side views are shown in Fig. 3. The jack at the forward end, Figs. 3 and 7, is made from two pieces of pipe, the sliding member or leg being cut from 1½-in. pipe. This telescopes into a sleeve of 2-in. pipe welded to the drawbar. Holes are drilled in the two members to take adjusting pins, Fig. 7. Side members of the frame are 3-in. steel channels strengthened by angle-iron cross braces, or spreaders. The legs of both channels are notched at a point near the forward ends and the channels are bent inward, the ends being welded to a length of 3-in. pipe to form the drawbar. Dimensions are not given on these parts as size must be determined during assembly.

Note that the frame for the wooden hopper is made from angle iron, with a channel formed in the upright angle at each corner by welding in a strip of flat iron as in the upper detail in Fig. 6. Ends of the wooden sideboards fit loosely in these channels. In order to drive the auger in a counterclockwise direction through the transmission, the Cadillac rear axle is in-

stalled upside down, the spring seats being welded or bolted to the trailer frame. A U-shaped strap welded to an angle-iron cross brace of the frame supports the drive-shaft housing, Fig. 6. A 4-in. drive sprocket is fitted on the end of the drive shaft. This drives a countershaft which, in turn, drives the transmission. The drive assembly is shown in the lower left-hand detail, Fig. 6. The bracket and support arrangement shown in Fig. 6 must be fitted to the transmission at the time of assembly.

The hopper bottom boards are set at a 45-deg. angle with the sides and are covered with sheet metal. Rear end of the auger carries the hopper contents into a cylinder or distributor head, made from 6-in. pipe to which a flange is welded as in Fig. 5. Holes are drilled in this flange so that it may be bolted to a triangular-shaped steel plate which, in turn, is bolted to the end of the V-section of the hopper in the same manner as a similar plate is attached to the opposite end of the hopper back of the transmission. Flanged bearings attached to the plate at the front of the hopper and to the back of the distributor head carry the auger shaft. Square openings are cut in the distributor head, Fig. 5,



and adjustable sheet-metal gates fitted over these openings control the amount of material fed to the spreader hopper. The adjustment of these gates provides for feeding various materials to the spreader in sufficient amounts to maintain a uniform rate of spreading. Usually, the spreader unit is provided with an adjustable gate with which settings can be made by means of a scale and pointer to distribute varying quantities of material per acre. The three-speed auto transmission permits changing the speed of the auger. This provision, in addition to the control gates in the distributor head and the variable-gate settings in the spreader, gives a range of adjustment which makes it possible to spread almost any quantity of fertilizer per acre. The drive chain for the spreader is carried over an idler mounted on the rear of the frame, Fig. 3. Although the drive sprocket is shown mounted inside the trailer wheel, some users will prefer to have it mounted outside the wheel so that the chain can be removed when the trailer is to be used for other purposes or hauled idle for long distances. With minor changes in dimensions, other auto parts can be substituted for those specified. However, the ones specified were found to be best suited for the purpose. When the unit is to be stored, oil all metal parts to prevent corrosion.

FIGURINE PAINTING

Here's an excellent hobby for anyone—the fascinating and profitable pastime of decorating plaster figures to produce beautiful replicas of Dresden china without actual firing or baking



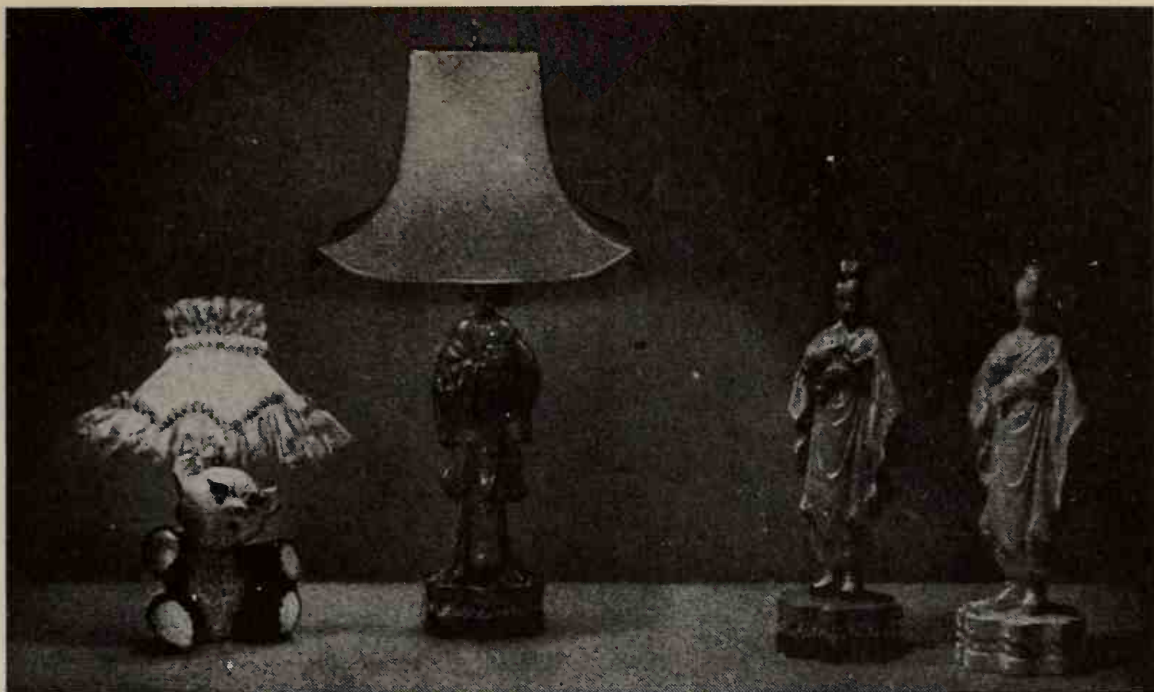
PAINTING Dresden figurines is a hobby that requires no special artistic talent. Even your first results will amaze you, and there's spare-time money to be had in painting these pieces for your friends and neighbors. You buy the plain plaster castings and start from there, decorating them with special paints which produce a beautiful glazed finish closely resembling real kiln-fired china.

Porcelain-like lace on the figures actually is cloth lace which is cemented to the casting and then stiffened by painting. The examples pictured here are but a few of the many different plaster figures available on store counters. The dainty colonial figures shown above and to the left come under the classification of Dresden figurines. However, there are many plain objects available in the form of lamps, cigarette boxes, Oriental figures, etc., that are less difficult to decorate and easy even for the small boy or girl to attempt. It's this utter simplicity, plus the professional-looking results, that accounts for the popularity of this hobby.

Selecting your castings: An important preliminary step is the selection of the casting. Examine it carefully to see that there are no major flaws in the plaster, such as air bubbles, chips or pitted areas, and that features, hands, ruffles and other lines in the casting are clean cut. This will get you off to a good start, resulting in less work and a much better finishing job. If there are a few tiny nibs here and there in the plaster, take the time to sand them

Wine, powder blue, powder pink and white are the colors recommended for the whispering couple pictured at the left. Base scrollwork, vest and coat lining, and edges of lace, could be done in gold





down with fine sandpaper. A smooth painting surface is important.

Application of lace: While the design of the figure determines to some extent where lace can be applied, there's no set rule as to where it must go—you can add it wherever you like, whether it be at the neckline, the sleeves or the hemline of a skirt. Applying the lace is very easy. Usually you'll find a ruffle line in the casting which serves as a guide to follow in cementing the lace around the figure. The lace is first gathered or shirred by drawing a top thread. This

Here are examples of plain "figurine" painting in the form of lamp bases. Chartreuse, red, gold and black are predominant colors for Oriental figures like these

provides a natural ruffle effect. Now, using regular quick-setting household tube cement, apply a line of cement completely around the casting. Then, starting at the back of the figure, place the top edge of the lace in the wet cement and hold it in position momentarily with a toothpick until the cement begins to set. Although the cement sets quickly and requires working fairly fast, there is time to adjust the lace as you want it. Remember to make the join in the lace come at the back of the figure. When all the lace ruffling is applied,

The group below are typical examples of Dresden-type figurines. Pearling treatment, the final step, will give such figures the fired look of real Dresden china





To prevent the network of the lace from filling up with paint, blow through the lace as you apply the paint. A soda straw will be ideal for this purpose

add any small bouquets or ribbons you plan to use for additional daintiness. All the trimmings must be in place before you start to paint.

Undercoating comes next: When the lace, flowers and other bits of trimming have been cemented in place, the entire figure is given a generous coating of undercoater. This is applied over everything—lace, flowers, ribbons, etc. In applying it to the lace, avoid closing up the mesh by blowing through it as you continue to paint. Best results are obtained by blowing through a

Oriental figures are very popular. The grouping below, as well as the couple shown at the right, are some additional examples of plain figurine painting



These designs serve as patterns to follow in adding eyes and floral sprays to your figurines. The iris of the eye shown as white often is painted lavender

soda straw. This is an important step—keeping the lace open—and one which results in a better looking figurine. If one coat does not make the lacework stiff enough, apply a second, and even a third coat if necessary, the idea being to make the lace look and feel like a part of the casting. The undercoat is fast-drying and you can start coloring your figure almost immediately. Ready-mixed paints are available in shades ready for direct application—others require mixing to obtain the right tint. Stick to the pastel shades as these take on a richer look than dark colors when pearled in the final step. Pop-bottle caps are ideal containers for mixing small quantities of paint, and mixing deep colors





Before-and-after views of colonial Dresden figurine

with white will produce pastel tones of delicate hues. If you are undecided as to what colors to use, refer to the chart on this page which lists combinations of three harmonious colors. First, flesh tones are applied to face, hands, arms and shoulders, then the other colors are added, all except the gold trimming which is applied last. In painting the lace with the finish coat, remember to blow through the material as before. When all of the colors have been applied, let the figurine dry for about 12 hrs.

Pearling follows painting: Pearling is the step that gives the fired look or porcelainized finish. This is done by dusting the figurine sparingly with a special pearl powder and then buffing briskly with a soft cloth or wad of cotton. The pearling changes black to a lovely iridescent finish and makes white look like mother-of-pearl. After the pearling step is completed, parts to be done in gold are painted. Do not make the mistake of pearling the gold as this will dull its rich color.

Features are last: Adding features, eyes and mouth requires practice and it's best to practice by painting them on paper. To paint eyes, first draw a small circle to form the pupil. Then with a small brush, No. 0 or 00, draw a narrow line across the top of the pupil to represent lashes.

Blending Primary Colors

Red+blue=purple	Purple+blue=violet
Blue+yellow=green	Green+blue=aqua
Yellow+red=orange	Green+yellow=emerald
Purple+red=magenta	Orange+yellow=ocher
Orange+red=vermillion	Red+blue+yellow=brown

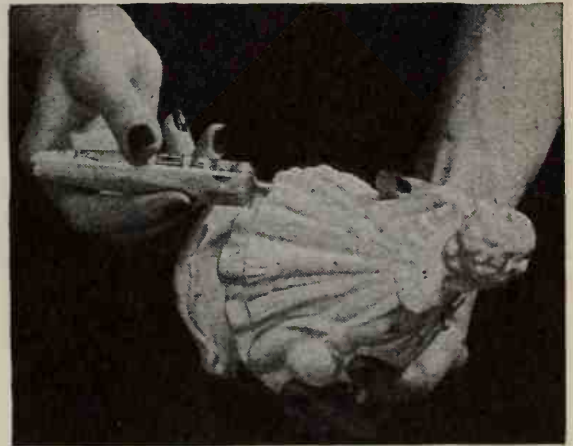
Pleasing Color Combinations

Purple — lavender — salmon
 Lavender — gray — yellow
 Powder blue — powder pink — white
 Old rose — powder blue — white
 Wine — lime yellow
 Chartreuse — forest green — red
 Brown — old rose — gray
 Wine — turquoise — white
 Turquoise — yellow — brown

(The above colors are standard ready-mixed shades)



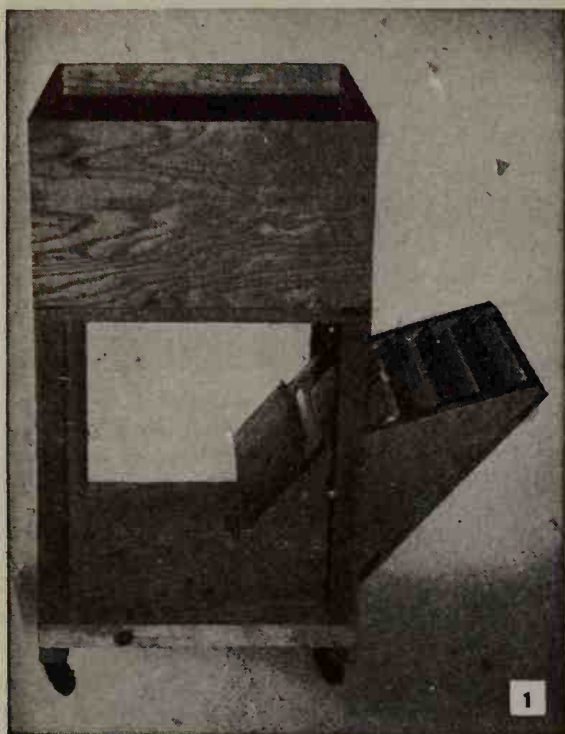
Common cotton lace which is cemented to the plaster figure is first gathered or shirred by pulling the top thread in the lace and ruffling it uniformly



Above, quick-setting household cement is used to attach the lace to the figure. This is applied all around the ruffle line cast in the figure. Below, toothpick is ideal for holding the lace in place and adjusting it for position. Blowing on cement hastens setting

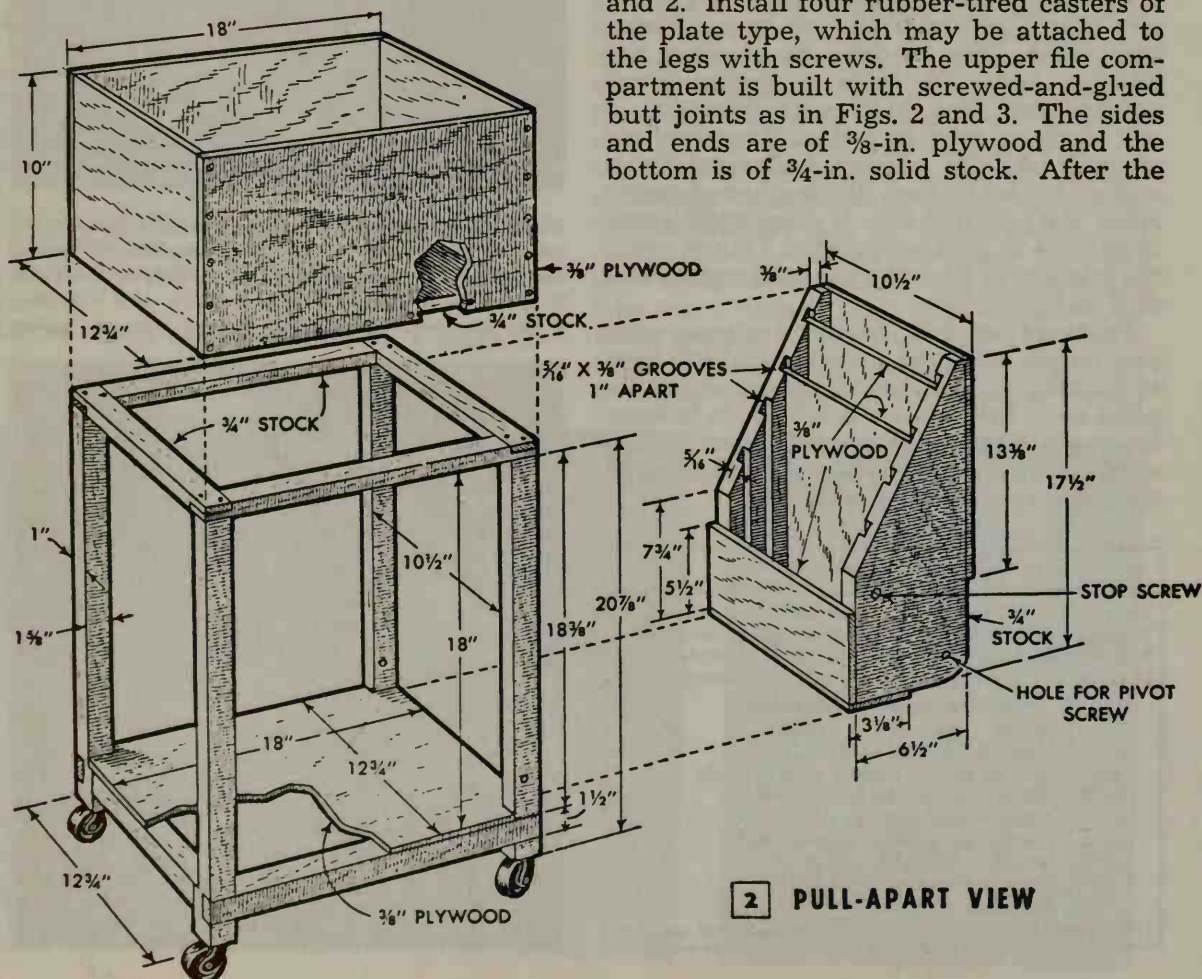


FILE CABINET



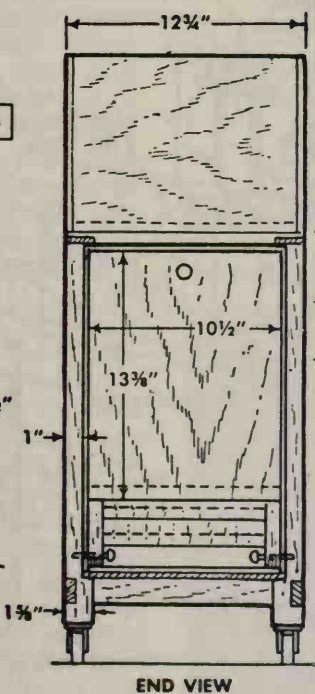
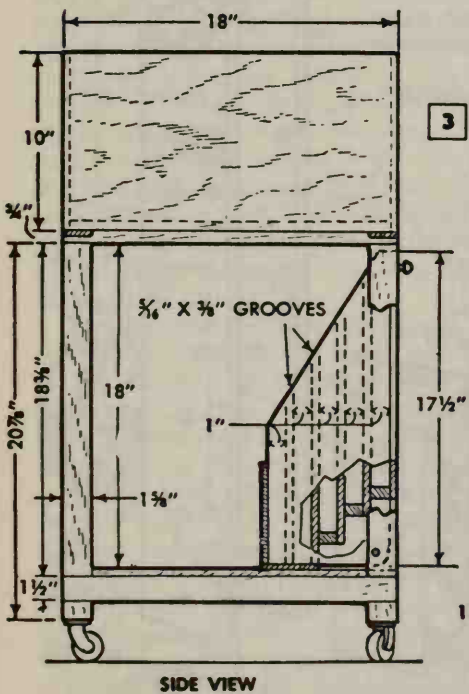
This handy rolling file, with its novel swing-out compartment, is a must for the home office or darkroom where filing space is necessarily kept at a minimum

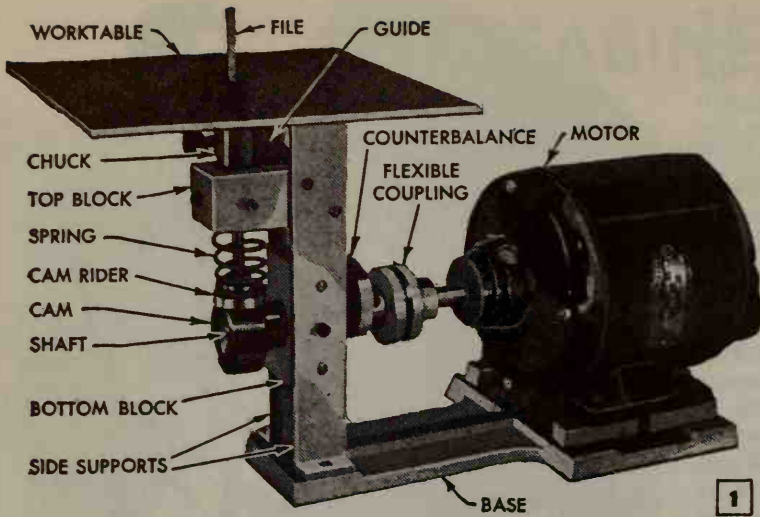
MADE almost entirely from plywood, the top compartment of this portable file accommodates standard letter-size file folders while the swing-out compartment provides ample space for an assortment of stationery. The base, Fig. 2, supports the filing units and consists of four legs assembled with stretchers and cross members at the bottom. Note that the ends of the stretchers are housed in grooves cut in the legs. The cross members are butt-joined, doweled and glued to the legs. Next, a rectangular frame is lap-joined at the corners and attached to the top ends of the legs with screws, or nails, and glue. Then a plywood shelf is neatly notched around the legs and joined to the stretchers and cross members with screws as in Figs. 1 and 2. Install four rubber-tired casters of the plate type, which may be attached to the legs with screws. The upper file compartment is built with screwed-and-glued butt joints as in Figs. 2 and 3. The sides and ends are of $\frac{3}{8}$ -in. plywood and the bottom is of $\frac{3}{4}$ -in. solid stock. After the



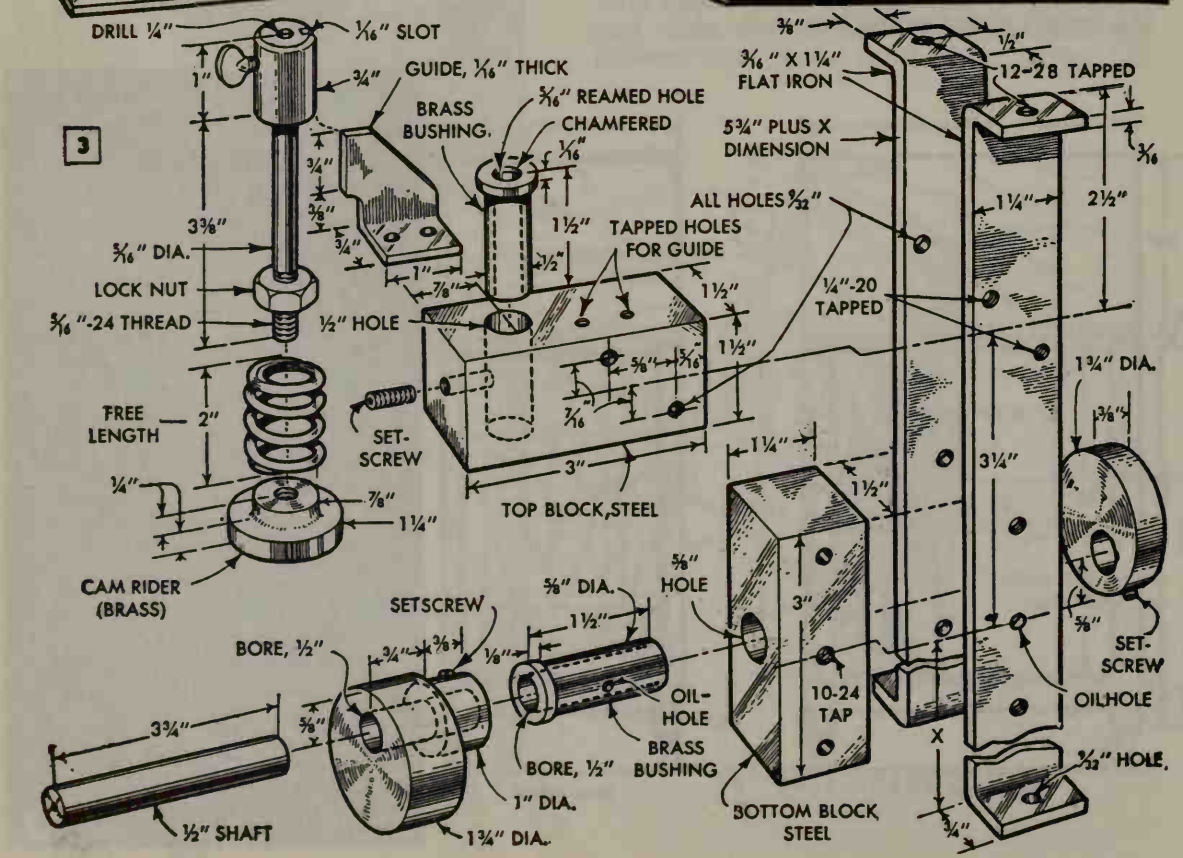
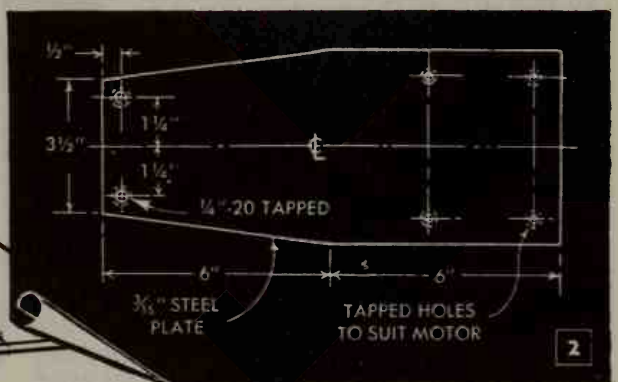
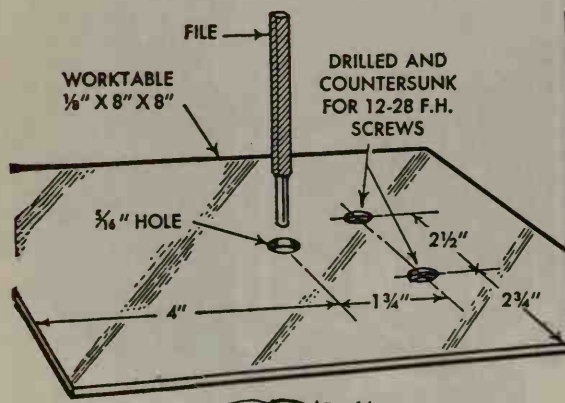
2 PULL-APART VIEW

box has been assembled, sand it thoroughly. It can be finished either in the natural color of the wood or enameled in color to match other furnishings. As shown in the cutaway view, Fig. 3, the swing-out unit is fitted with stepped compartments which are all of a uniform depth. The dividers are of $\frac{3}{8}$ -in. plywood and are fitted in grooves cut in the sides. Solid stock is used for the sidepieces but all other parts are of plywood. Note in Fig. 2 that a radius is cut on the lower front corner of the sidepieces so that the unit can swing outward without striking the shelf. When installing the unit, the pivot screws are driven into the legs from the inside as in Fig. 3. Use round-headed screws and be careful not to drill the pilot holes clear through the legs. Leave the screws slack so that the unit will pivot easily. After installing, determine the balancing point of the unit, and then drive a stop screw into one side as in Fig. 2. This will hold the unit in the open position as in Fig. 1. Note in Fig. 3 that the total height of the completed file is $31\frac{1}{2}$ in., not including the casters. If you wish the top of the file to be exactly desk height, Fig. 4, allowance must be made in the length of the legs and the height of the swing-out unit.





Both modelmakers and die makers will like the precise internal and external filing this machine can do on a wide variety of small intricate work. It uses the standard machine file

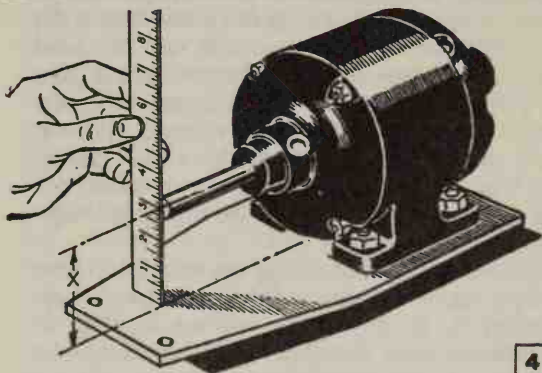


FILING MACHINE

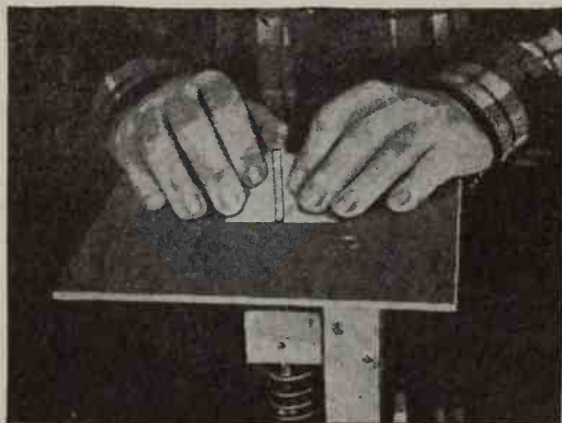
INSIDE OR OUTSIDE die filing, squaring small parts, and truing irregular inside or outside shapes in model work—these are jobs for this motor-driven filer. Fit it with a special chuck to take saber-type blades and you have a speedy jigsaw. No castings are used, only cold-rolled round, flat and bar stock in standard sizes. Fig. 1 shows the complete machine and names all principal parts. Dimensions of these are given in Fig. 3, while Fig. 2 details the base. Dimension "X," Fig. 4, determines the position of the bottom or bearing block, Fig. 3. Check this dimension first so that you'll know where to locate holes in the side supports. In order to get the motor shaft and drive shaft in alignment it may be necessary to shim under the motor as in Fig. 1.

Note that there is a flanged brass bushing in the bottom block, which forms the bearing for the main shaft. This bushing should be reamed to a precision fit on the drive shaft. The cam is cold-rolled steel and the cam rider is brass or bronze. Cam and rider are ground and polished on the meeting faces. The top block also is fitted with a flanged bushing of either brass or bronze, and forms a bearing for the file spindle. As these parts travel at fairly high speeds, ream the bushing to a precision fit on the shaft. The spring can be made by winding No. 8 phosphor-bronze wire on a $\frac{1}{2}$ -in. mandrel in a lathe. Free length of the spring should be 2 in. When removed from the mandrel, the coils will expand to about $\frac{7}{8}$ -in. inside diameter. A stock spring also can be used. The chuck and spindle are turned from one piece and the body of the chuck is slotted for a guide which prevents it from turning. This slot can be cut with a shaper, milled, or filed by hand. It is essential that the guide be a close fit in the slot.

The counterbalance is of steel, and does not fully balance the cam, for there also is the tension of the spring to overcome. The size of the counterbalance detailed was determined experimentally and was found to be correct for this machine. Use a $\frac{1}{4}$ -hp. 1750-r.p.m. motor and connect it to the main shaft of the machine with a flexible coupling. When the machine is to be used continuously it's best to fit pressure-grease fittings or snap-cover oil cups provided with felt wicks. A felt washer cut to fit snugly over the spindle just underneath the chuck will prevent metal filings from reaching the bearing.



Above, be sure of this dimension as it will vary with different motors. Below, standard machine files with $\frac{1}{4}$ -in. round shanks are used. By fitting an interchangeable chuck, machine makes a speedy jigsaw.



FILING SYSTEM



IF YOU HAVE ever spent a lot of time searching in a multiple-drawer shop cabinet for some item badly needed at the moment, then you can appreciate the efficiency and speed of this simple shop-filing system. It is set up for a cabinet with any number of drawers, or it can be used with a number of small boxes, glass jars or other individual containers, to store such items as bolts, nuts, washers, screws, steel wool, felt, small tools, radio parts, etc. The same system will serve when filing photo negatives or newspaper clippings in envelopes.

In setting up the filing system for items stored in a cabinet, first number each drawer 1, 2, 3 and so on, as in Fig. 2. Numbers are painted on the drawers free-hand, or applied with a stencil or rubber stamp. Proceed the same way in

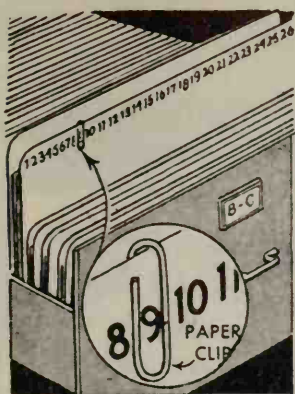


numbering other containers used in place of cabinet drawers. Each drawer of a storage cabinet may contain several different kinds of objects. Where this is so, it will be still handier to place each group of small articles, washers, nuts and the like, in a separate container which is placed in the drawer along with others containing other small parts. Then prepare an index with 3 by 5-in. cards and

file case such as that shown in the photo at the left of Fig. 1. List all items in each drawer on separate cards, Fig. 3, and file under the correct index letter, as washers, wire, worm gears, under "W," and so on through the alphabet. Place all these items listed under "W" in one drawer. In many cases it is possible to label the container or object with the number of the drawer it is kept in as in Figs. 1 and 4. In this way a container or part which has been taken from the drawer to the bench may be returned to the same drawer without consulting the index to determine its proper place.



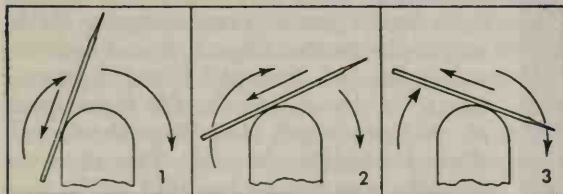
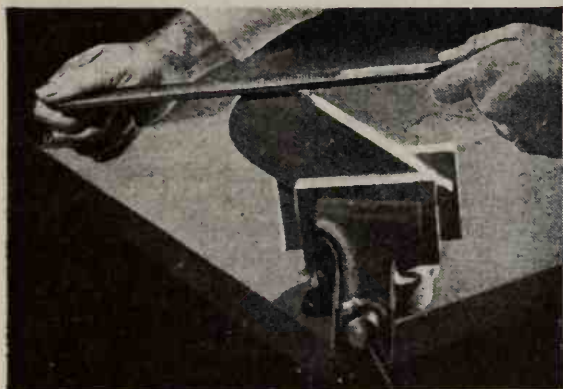
Files Are Used for "Follow Ups"



A simple "follow up" file system may be set up by marking an ordinary file folder along the top edge with the numerals 1 to 31. Then slip a paper clip over the number that represents the day of the month when the file is to be brought to the proper person's at-

tention. Months could be marked on the file also and noted with a clip in the same manner.

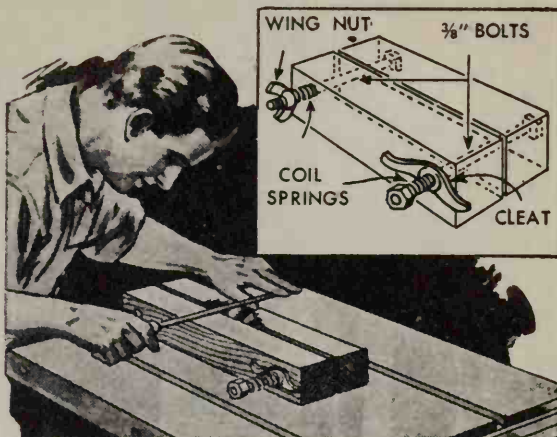
FILING TECHNIQUES



Technique of Filing a Radius

Rounding the corners of either wood or steel stock can be a simple job once you learn this technique. The secret lies in moving the file with a rocking motion, starting at the end of the cut farthest from you and working backward, as pictured in the three steps below. Note that the angle of the file constantly changes for each stroke, resulting in a uniform removal of stock from the curved surface. Keep in mind that the two movements of the file (forward and downward toward the work) are made at the same time.

Bench-Saw Blade Filed Quickly If Held With Spring Clamp

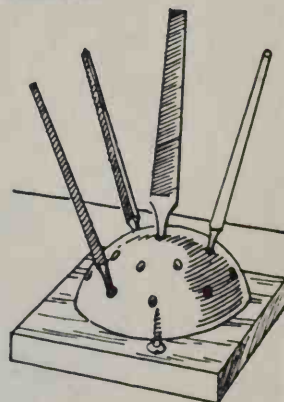


Touching up the teeth of a circular-saw blade is done in a jiffy if the blade is kept from rotating by this easily released clamp. The clamp jaws are formed from two blocks of wood, 10 or more inches long depending on the size of the blade. The blocks are joined together by two bolts passed through aligning holes drilled near the ends of the jaws. Short coil springs are slipped over the ends of both bolts. One spring is held in place with a wing nut, and the other spring is slipped on the second bolt over an awning cleat. This spring is tightened against the cleat with a regular nut. To use the clamp, the jaws are set over the saw blade and the blade is raised until it projects $\frac{1}{2}$ to 1 in. above the jaws. Both nuts are tightened to apply enough pressure on the blade to keep it from rotating while being filed. After the exposed teeth have been touched up, the awning cleat is drawn back with the fingers, thus releasing the clamping pressure and allowing the blade to be moved in order to expose the next two or three teeth.

Croquet-Ball File Holder

Excellent holders for files, punches and nail sets can be made by mounting half of a discarded croquet ball on a wooden block. After sawing the ball in half, drill a number of holes in the rounded surface of one of the halves to take the tangs or tips of the tools.

Then fasten the flat side of the drilled holder to the base block by using glue and a flat-headed screw which is driven flush with the underside of the base.





To select the right file for the job every craftsman should know files and how to use them — he should know file size, cut, length, pattern, style and kind

FILING

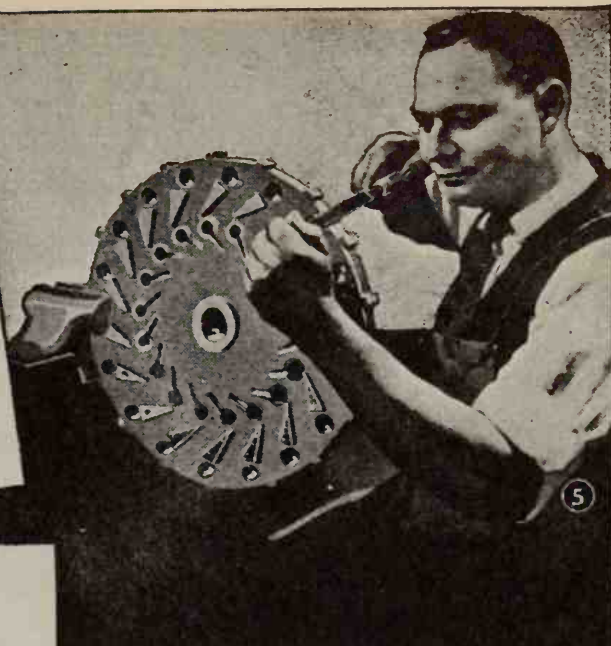
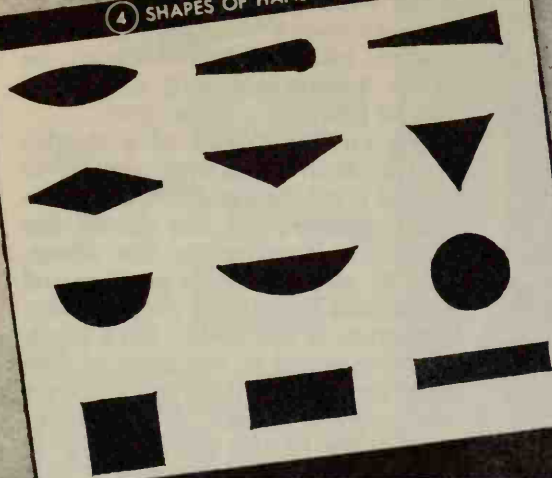
LIKE many other hand tools, in the use of which the worker's grip, stroke and pressure must be varied to suit the job, the proper use of the hand file requires the development of manual skill. There are three ways of using a file—straight filing, draw-filing and lathe filing. Straight filing includes perhaps the widest application of hand files; in general, it is an operation consisting simply of pushing the file in a lengthwise stroke across the work at right angles to it or slightly diagonally as may be required. Since hand files are designed primarily to cut only on the forward stroke it is important that the file be lifted or "carried" on the back stroke so that it does not touch the work, in order to prevent unnecessary dulling of the teeth. Figs. 2, 3 and 5 show examples of straight-filing operations. In drawfiling the file is gripped at each end and is both pushed and drawn over the work. The strokes usually are made parallel with the length of the work, and the file is held at right angles to it as shown in Fig. 21. Drawfiling thus differs from straight filing since both the forward and back strokes are cutting or "work" strokes. Lathe filing is commonly done, as indicated in Fig. 9, by stroking the file lightly over the surface of work being rotated in a lathe.

Among the first things anyone should know about hand files are: the method used to measure files, the sectional shapes of files commonly used and the basic "cuts" of files, the



HAND POSITION IN STRAIGHT FILING

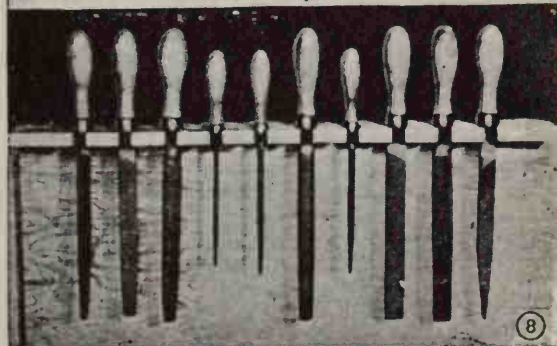
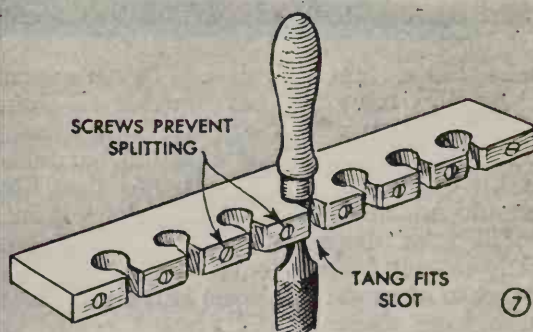
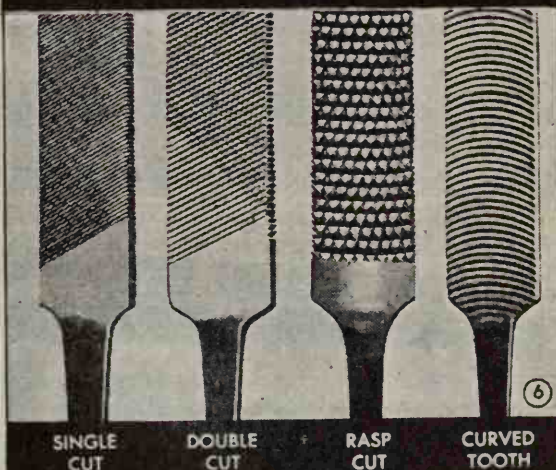
④ SHAPES OF HAND FILES

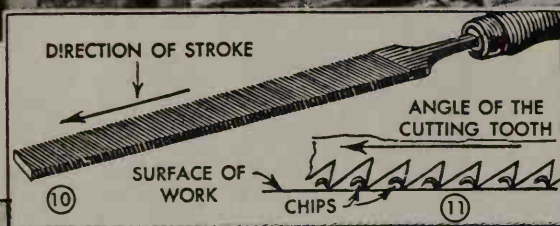


TECHNIQUES

latter term referring in general to the coarseness and arrangement of the teeth. Fig. 1 shows the accepted method of measuring a file from tip to tang, a 10-in. file measuring 10 in. within these limits, and an 8-in. file 8 in. and so on. Sectional shapes of common files are given in Fig. 4. These cross-sectioned shapes are in no way indicative of file size, but show only the types or styles, such as flat, round, half-round, square, triangular, etc. As you can see from Fig. 4, there are three general classifications—circular, quadrangular, and triangular. There also are other irregular forms which are sometimes classified as “miscellaneous.” Fig. 6 shows how the “cut” of common files is designated basically, the terms single cut, double cut, rasp cut, curved tooth, and so on referring to the kind of teeth. The relative coarseness of the teeth from extreme coarse to very fine is designated by the terms rough, coarse, bastard, second cut, smooth and dead smooth.

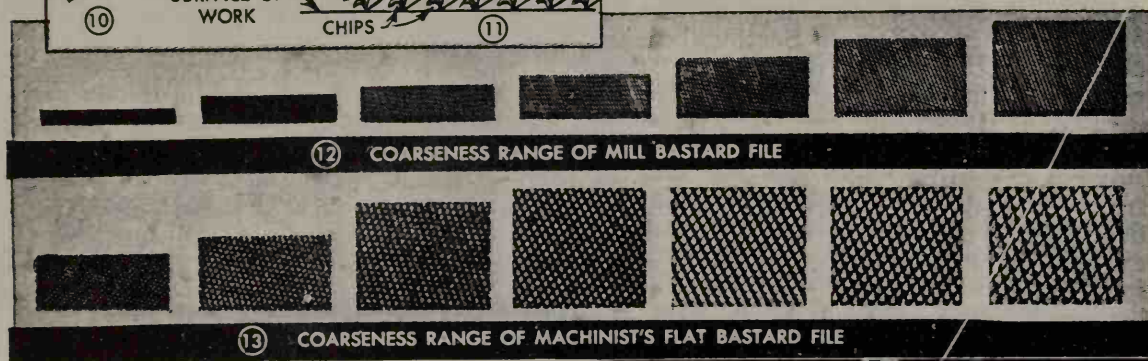
In general, the single-cut file is used most commonly under relatively light pressure for surface-finishing operations and for edging sharp tools. The double-cut file is designed for faster removal of metal and the use of heavier pressures where extreme accuracy and smooth finish are not essential. The rasp-cut file, or rasp, is used principally on wood but also can be used effectively on lead, solder, animal hoofs, certain plastics, aluminum, etc., where fast removal of material is the prime requirement. When working on aluminum and steel sheets and particularly in auto body and fender work, hand filers use the curved-tooth file, which can be ob-





can be obtained at nominal cost. A file rack should be attached to the wall above your bench, not to a panel attached to the bench, as heavy hammering will cause the files to fall out.

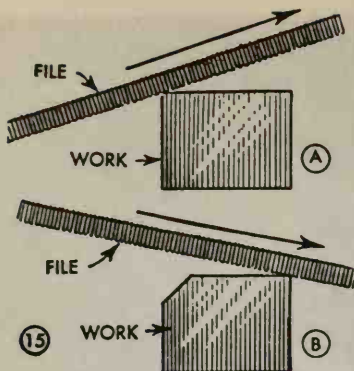
The cutting action of a single-cut file on metal is very similar to that of a cabinet scraper on hardwood, except that the cut of the file tooth is more on the shear. Fig. 10 shows the direction of stroke and Fig. 11 the chip-removing action of file teeth. Each tooth removes metal in the form of fine chips as it passes over the work on the forward stroke. The coarseness range of the common file is related to the cutting action in that the size of the teeth varies with the size of the file, as will be noted from Figs. 12 and 13. The longer files generally are made proportionally larger in sectional size. It should be kept in mind that it is a commonly accepted practice to select and use files that are more or less proportional to the size and



tained in a rigid as well as a flexible form.

As files have a great number of sharp cutting edges which can be dulled easily by contact with metals of equal hardness, it always must be remembered that files should not be thrown together loosely in a toolbox or drawer either by themselves only or with other tools. One of the best ways to keep various sizes of files together, safe from damage and always ready for use, is to make a simple rack of the kind shown in Figs. 7 and 8. This can be made from a piece of $\frac{3}{4}$ by 2-in. wood, cut to whatever length required to hold the number of files in regular use. Holes large enough to receive the tangs are drilled in the wood, and notches narrower than the diameter of the holes are cut in from the edge. All files should be fitted with individual handles, preferably having rounded ends. These are made especially for the purpose by various file manufacturers and





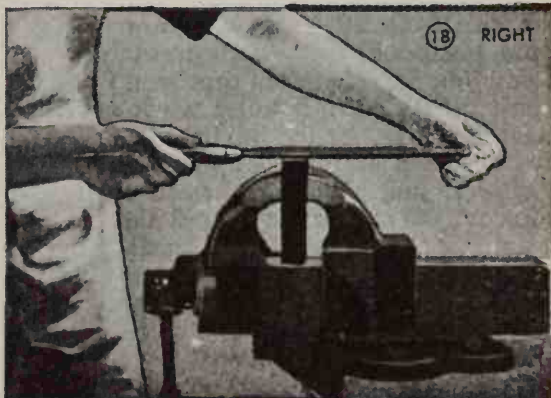
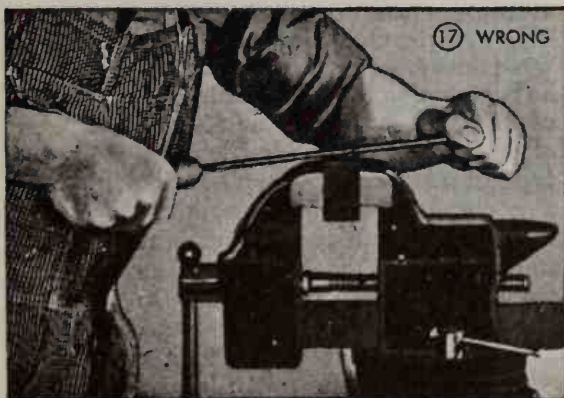
nature of the work. For example, the type of work shown in Fig. 14 would ordinarily call for the use of a medium large double-cut machinist's file, since even though the measurement required to bring the work to finish size might be small, the amount of material to be removed would still be considerable owing to the sectional size of the work.

Details A and B of Fig. 15 will serve in the illustration of two important points in hand-filing procedure. Assuming, for example, that the requirement is to bevel the edges of work as indicated in detail B, if the work is 6 in. or more in length, the bevels are more easily cut by drawfiling along the edges, but if the stock is nearly square the file strokes must be made at right angles to the edge. Experienced hand filers usually do this and similar jobs by first beveling the edge farthest away. If you start beveling on the near edge, the file is likely to chatter and clog, and moreover, you are apt to damage the teeth.

When doing both straight filing and drawfiling, the work generally is held in a vise. Here the height of the work is important. Ordinarily, for average light work, the jaws of a vise should be just above



elbow height, although when doing heavier work often it is more convenient to have the work positioned a little lower. Figs. 17 and 18 picture in a general way the right and wrong methods of holding a file in straight-filing operations. It takes some diligent practice to acquire the knack of "carrying" or "stroking" the file to produce a true, flat surface. If the file is gripped as shown in Fig. 17, and the stroke is made under heavy pressure, the action of the file will be similar to that indicated in the two details of Fig. 15 and the result will be more or less of a convex surface instead of a perfectly level surface as desired. The trick is to carry the file forward in as straight a line as possible and to apply just sufficient pressure, equalized with both hands, to keep the file cutting. Of course,



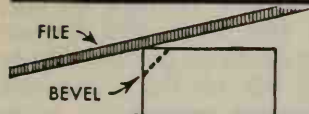


this applies to the longitudinal stroke only. On some materials it's necessary to change the course of the file slightly to prevent grooving. Sometimes the job calls for flat surfaces to be filed on adjacent sides of a right-angle section as is shown in Fig. 16. In doing this job the filer uses a file made with one blank, or "safe" edge. This feature of the file enables the operator to work into a corner without grooving or marring the adjacent surface.

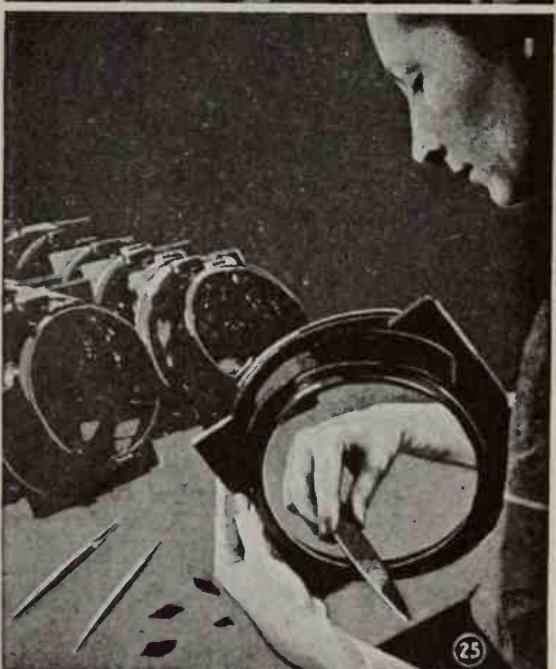
Figs. 19 to 26 inclusive show various hand positions of skilled operators when doing jobs ranging from precision filing on small parts to the heavier work on large machine parts. As the job becomes specific the selection of files becomes equally so. For example, the experienced mechanic does not use an ordinary hand file for such rough work as "snagging" castings. For this particular work it is necessary to use a special foundry file, which is made with extra heavy teeth shaped to withstand the shock of being driven against the hard projections and sharp edges encountered in

this kind of work. For filing on angles, curves, holes and slots found in fine-instrument assembly, jewelry making and repair, modelmaking and die sinking, the skilled mechanic keeps at hand a suitable assortment of the variety of shapes, sizes and cuts of the small precision files known generally as Swiss pattern files. In Figs. 19 and 23, you see these tiny precision files in use by skilled operators. Objects difficult to hold in a vise because of shape or the danger of breakage are usually held by or in one hand as shown in Figs. 20 and 25. Or use can be made of a filing block, which is simply a piece of hard, close-grained wood having a number of grooves of varying size cut in one or more of its sides. Filing blocks are used chiefly for holding small rods, pins, etc. To prevent marring work held in a vise, a pair of soft-metal pads often are put between the vise jaws and the work. Fig. 22 and the detail below it show how the bevel is started in a manner to ease the strain on the file teeth.

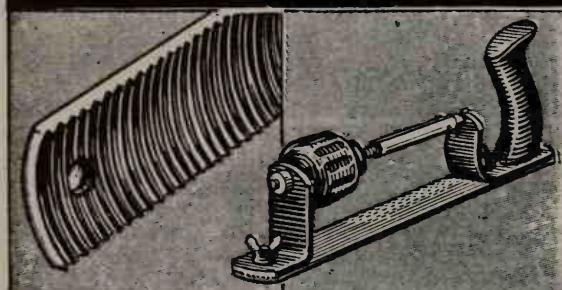
The great increase in the use of new metals and metal alloys has made necessary the designing of new files for special purposes. Figs. 27 to 31 inclusive show a number of these. The curved-tooth file shown in Figs. 27 and 28 is used universally by manufacturers and auto-body repair shops, and by those who work on sheet steel and aluminum and other softer metals. The files are provided with a tang for use of the conventional handle, or plain with a hole at each end for attachment to a holder of the type shown in the right-hand detail of Fig. 28. The flexible files of this special type fit a number of curved holders. They also come in fine and smooth cuts and in flat, square, half-round and other conventional styles. Figs. 29, 30 and 31 show comparisons between regular and special files. The lathe file, aluminum file and brass file, shown at the left in Figs. 29, 30 and 31, are compared with the mill file and the ordi-



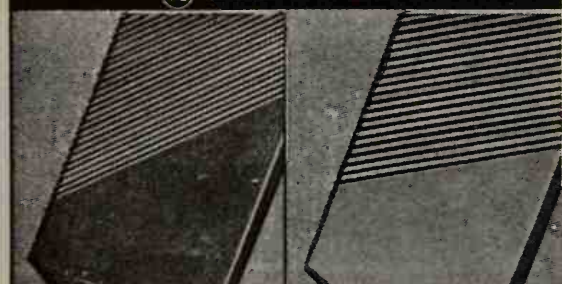
nary flat file detailed on the right-hand side. In addition to the forms shown, there are many others. For example, one particular file is furnished especially for producing a smooth finish on soft metals or their alloys, plastics, hard rubber and wood. It is similar to the ordinary mill file except that it is made in coarse single cut with a long-angle shear tooth. Another, especially made for smooth filing lead, is furnished with coarse teeth cut nearly square across at right angles to the length, thus resulting in a series of straight "blades" which shear away the soft metal very rapidly. Fig. 32 shows the common wood rasp in use. Another file also is made for working in wood. It is similar to the machinist's flat bastard file except that the teeth are somewhat coarser.



FILES FOR SPECIAL PURPOSES



28 CURVED-TOOTH FILE



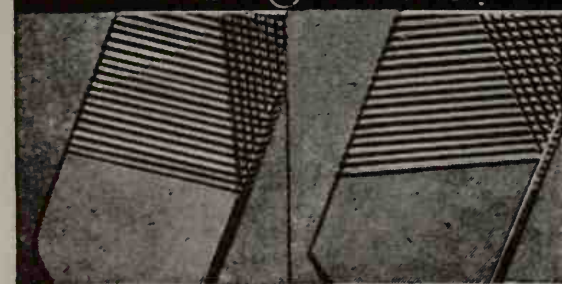
LONG-ANGLE LATHE FILE 29

MILL FILE



ALUMINUM FILE 30

FLAT FILE



BRASS FILE 31

FLAT FILE

Wherever files are used a file cleaner, or "card," should be kept handy for cleaning the files during and after use. Sometimes, on certain materials, even the right file for the purpose will show a persistent tendency to clog or "slug" with collections of chips. If cleaning thoroughly with the file card fails to correct the trouble, very often simply dusting the file and work with chalk will prove to be a good remedy. Always be sure that both the work and file are clean, free of oil or grease. Oil on either the file or the work will cause clogging, especially when using the fine-toothed files. Files rust easily if exposed to undue moisture conditions and any file used to clean up soldered joints on which acid flux was used will be ruined quickly by rust as some of the flux will get on the file.

Files thus exposed or those which are stored for a time can be protected with a coating of light machine oil, but the oil should be removed before the file is used. Carbon tetrachloride is a good solvent to use for the removal of oil and is not injurious to the file. Solutions of caustic acid also are used for the removal of grease and oil from metal surfaces, but care must be taken to remove all traces of acid from the files.

Photos and information by courtesy of the following: Nicholson File Co., Henry Disston & Sons, Inc., American Swiss File and Tool Co., and E. C. Atkins and Co.



FILM VIEWER



This viewer serves the three-fold purpose of a transparency viewer for all film from 8-mm. to the 4 by 5-in. cut-film size, an illuminated retouching easel for negatives and an aid in editing 8-mm. or 16-mm. movie film, Figs. 1, 2 and 3. It also can be used in editing 35-mm. film by fitting an adapter. Body of the viewer is made by cutting a 2-gallon can diagonally in half as you see in Figs. 5, 7 and 8. Lines where the cuts are to be made can be marked with a metal scriber. The diagonal cuts are made with a sharp, thin knife blade or similar tool. A pair of canvas gloves should be worn to protect the hands from injury. Smooth

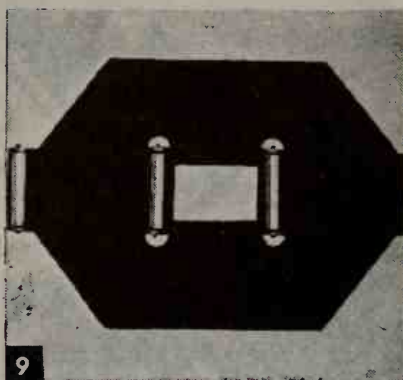
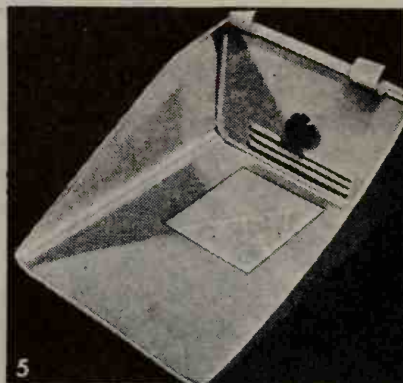
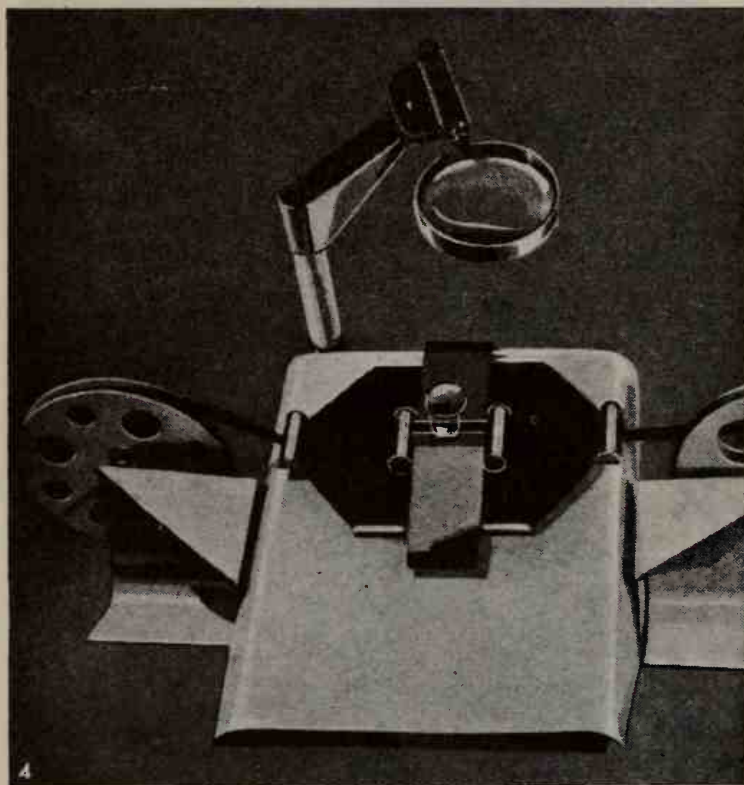
the cut edges with emery cloth or a file.

Figs. 5 and 8 show how two strips are left attached when cutting away the unwanted portion of the can. These are later rolled to form feet which raise the back about $\frac{3}{4}$ in. above the surface on which it rests. The air vent thus made, in addition to the opening at the front and the three louvers above the lamp socket, provides ample ventilation for the 25-watt bulb. If the viewer is to be used on a polished surface, the feet and the two front corners can be covered with several layers of photo tape or felt to prevent damage to the surface. Openings for the opal glass and lamp socket are cut by placing the work on the end grain of a wooden block and cutting along carefully marked lines with a ham-

mer and a sharp cold chisel. Louver slots in the end of the can above the lamp socket are cut with a knife. The opening for the lamp socket should be just the right size to grip the threads of the socket firmly when it is turned into the hole, Figs. 5 and 7. In making an assembly of this type, of light sheet metal, be especially careful to avoid bending or denting the material. Dents and bends are difficult to hammer out flat.

A piece of opal glass $4\frac{1}{4}$ by $5\frac{1}{2}$ in. is used to diffuse the light. The opening is cut to fit this glass and, to hold it centered above the bulb, a $\frac{3}{8}$ -in. tab is cut at the upper and lower ends of the opening, running the entire width. These tabs then are bent to make a sliding fit for the ends of the glass,

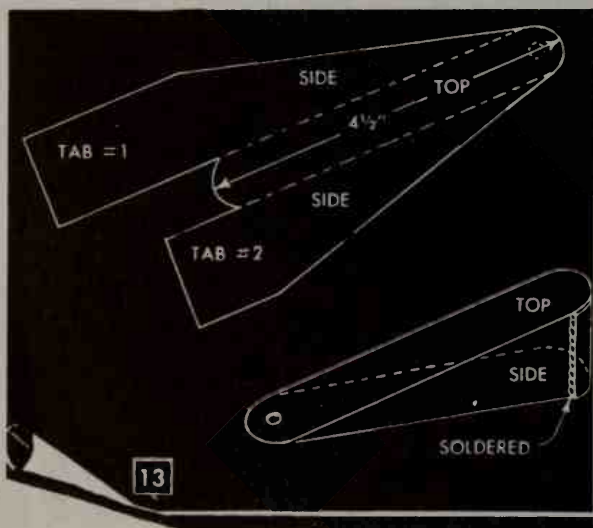
made from a piece of light sheet metal. It is large enough to cover the opal glass and it has a 1 by $1\frac{1}{2}$ -in. opening cut at its center. The film is guided by four wooden rollers, Figs. 2 and 4, attached to eight semicircular tabs cut out of the metal and bent at right angles to the adapter. The exact size of the tabs and rollers is not important but there should be about $\frac{1}{16}$ in. clearance between the roller and the surface of the adapter. Also, the rollers should turn freely. A small hole is punched in each of the tabs and nails or brads are inserted in the ends of the rollers through these holes.



holding it in place as in Figs. 6 and 7.

The adjustable magnifier holder, Figs. 3, 8 and 13, is made to hold a standard reading glass. It consists of a short wooden dowel and three other parts made of light sheet metal. The clamp, Fig. 8, is fastened to the viewer with two bolts and it clamps around the dowel with the aid of a bolt and wing nut, permitting the dowel to be locked in any position. A $4\frac{1}{2}$ -in. metal arm, detailed in Fig. 13, fits tightly over the top end of the dowel, and a swiveling clamp which holds the magnifying glass is connected to the arm by a bolt and wing nut. This arrangement permits the magnifier to be adjusted quickly and easily.

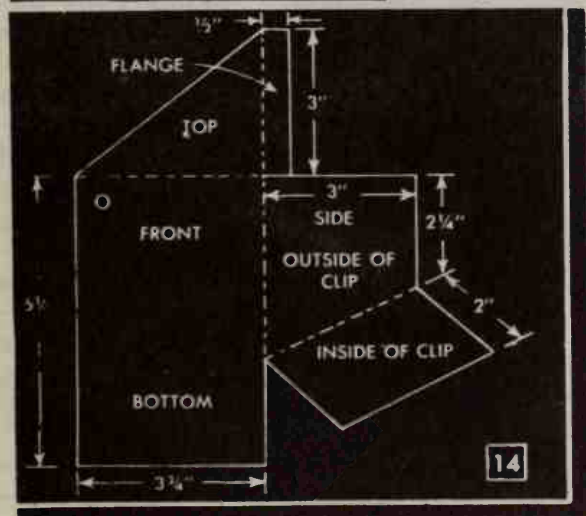
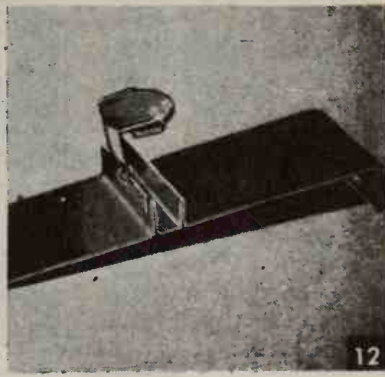
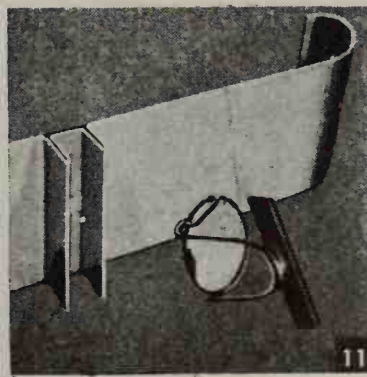
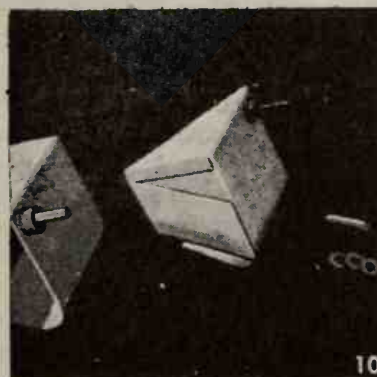
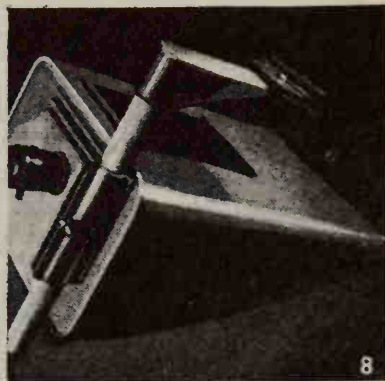
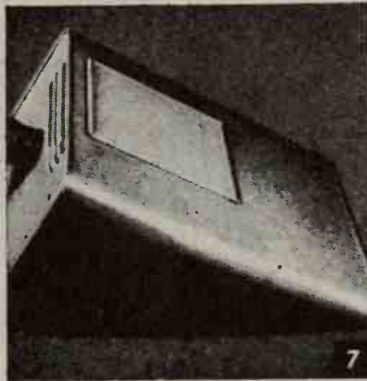
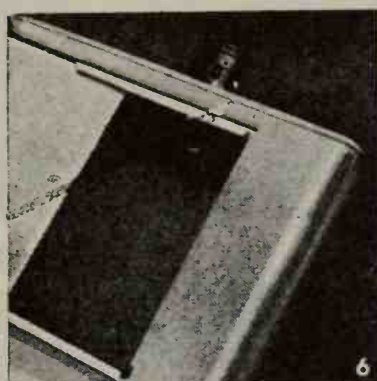
The adapter for 35-mm. film, Fig. 9, is



Using the viewer as an editor for 8-mm. or 16-mm. film requires only the addition of reel holders which clip to each side of the viewer and a film guide which fits over the center of the 35-mm. adapter, Figs. 4, 11 and 12. Fig. 4 shows the viewer being used for editing 8-mm. film. If you wish to use it for 16-mm. simply make the reel holders a little wider to accommodate the larger reels and make the film guide to fit 16-mm. film. The reel holders, Fig. 10, are each formed from a single piece of sheet metal. They are so made that they clip to the sides of the viewer and can be removed when not needed. Fig. 14 details the pat-

tern for the holders. Two $\frac{1}{4}$ by $1\frac{1}{2}$ -in. stove bolts serve as shafts on which the reels turn. They are fastened to the holders with a square nut and washer and the exposed threads are covered with a close-fitting sleeve made of sheet metal. Three washers are used on each shaft to permit the reels to turn freely.

The movie-film guide, Figs. 11 and 12, is made from a single strip of sheet metal $1\frac{5}{8}$ in. wide, rolled down at the top so it hangs over the upper end of the viewer as in Figs. 1 and 4. The 8-mm. guide is made by bending the strip at its center to form a channel 8 mm. wide with guides $\frac{3}{8}$ in. high at each side. A small rectangular opening equal in size to the 8-mm. frames is cut through at



the bottom of the channel to permit the light to shine through. This opening is cut out with a hammer and a very small cold chisel or a sharpened screwdriver.

A small but powerful magnifying glass is fitted into a holder which clips over one of the guide strips of the 8-mm. channel, Fig. 12. The holder for the magnifier is simply a strip of sheet metal bent double for clipping over the guide strip, to which is soldered a U-shaped piece of wire with the top ends bent at right angles and shaped to clip over the edges of the lens, Fig. 11. The chipped edge is bound with a narrow strip of photo tape. When completed, the viewer and the two film reel holders are coated with light blue enamel.

FINISHES

with Brush and Spray

Crackle, crystal, spatter and veiled finishes, as well as wrinkling, shading, smutting and many others applied to furniture and novelties

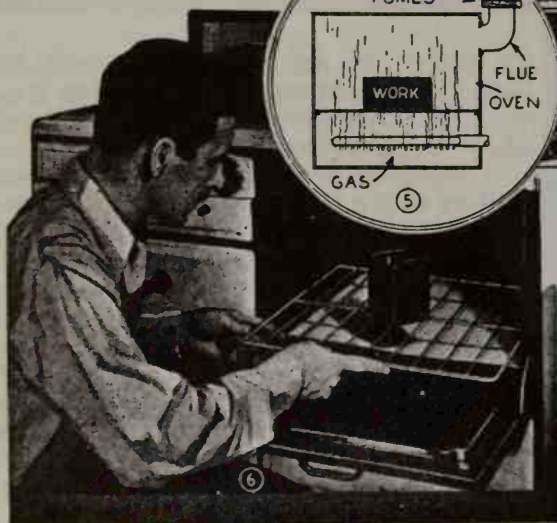
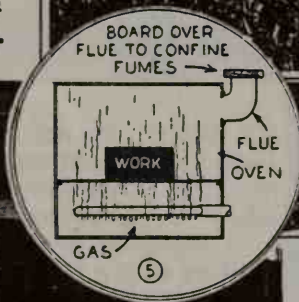
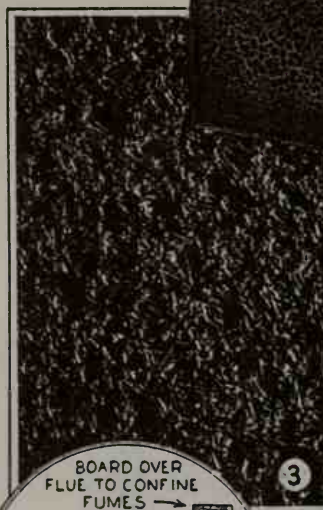
NOVELTY finishes of interesting textures and color combinations can be used to advantage in the home or professional shop. They are smart and distinctive, cost little if any more to apply than the usual smooth finish of one color, and can be applied readily without previous experience. Most of the effects require a spray gun for successful application, although some can be brushed or dipped.

Crackle: Crackle enamel is available either clear or in standard colors, and is applied over a lacquer undercoat.



It dries almost instantly and cannot hold its original overall coverage, but instead cracks into numerous small sections, as can be seen in

Figs. 1 and 2. Red crackle over black lacquer is commonly used to produce a Spanish vargueno or oriental effect. Other good combinations are brown over ivory, green over gold and blue over gray. After the under coat has dried, the crackle coat is sprayed on. The lighter this is applied, the smaller the cracks will



be. Some experience is required in order to get a uniform surface. For pleasing, transparent effects on polished metal, colored glass, or parchment mix clear crackle enamel, about 10 parts, to the desired color, 1 part. The base coat should be clear lacquer or a rich, yellow gold. In all cases, the crackle coat should be protected, when dry, with a coat of clear lacquer.

Wrinkling: One of the most popular finishes on all kinds of metal work is wrin-



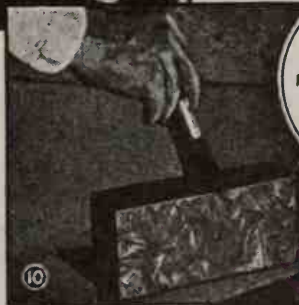
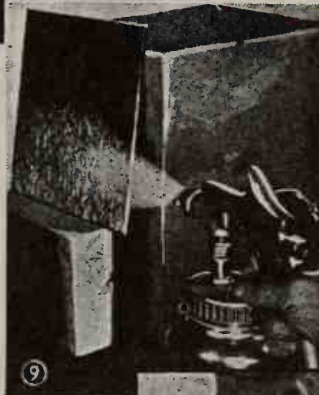
klings. The lacquer used is somewhat heavier than the average spraying lacquer. It is also sprayed, being applied best with pressure feed. Like most texture finishes, a thick coat gives a heavy, pronounced pattern, while a thin coat gives a fine-textured effect. A medium heavy coat works best. After spraying, the work is placed in an oven to bake. The temperature should be between 180 and 220 degrees Fahr. Fig. 3 shows the appearance of the wrinkling lacquer coat after baking. The baking time runs about 2 hrs. at 220 degrees.

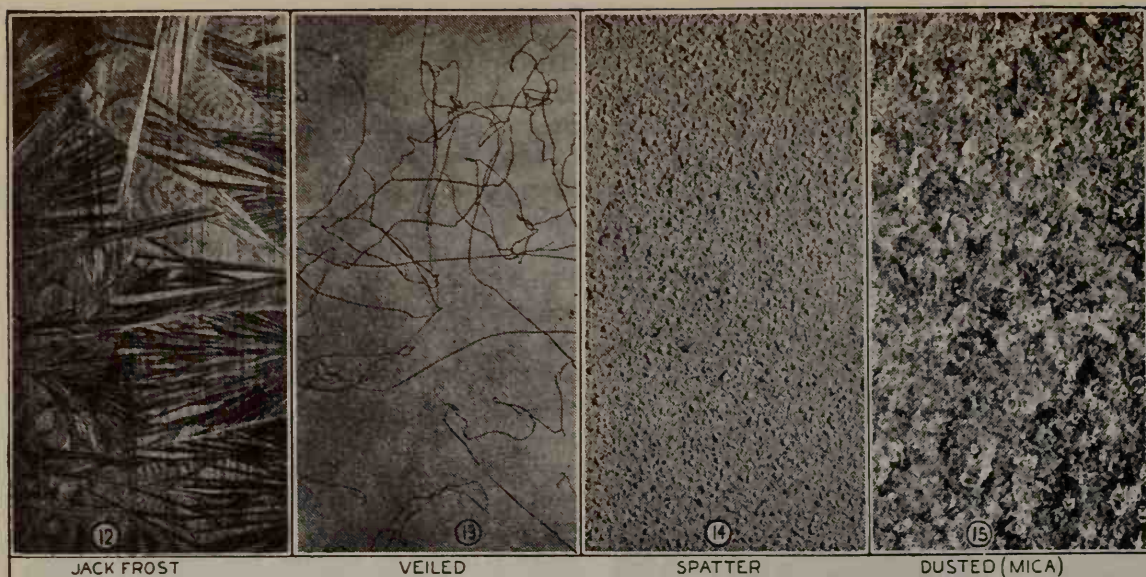
Crystal: Crystal or crystallizing lacquer is another baked-on finish. It comes in black and clear only. The general effect

can be seen in Fig. 4, and consists of very small crystals. A light coat gives best results. Like wrinkling lacquer it is sprayed direct without undercoats of any kind. In baking crystallizing lacquer, it is necessary to confine the products of combustion inside the oven, as shown in Fig. 5. Baking time is about 30 minutes at 150° Fahr., Fig. 6.

Shading: Shading or two-toning offers one of the simplest methods of securing a novelty effect on small furniture pieces, kitchen sets and the like. It is done by first applying a base coat, and then shading various parts of the work with a gun, as shown in Fig. 7. In a natural finish with clear lacquer, a special brown shading lacquer is used to secure the desired effect. Color shading can be done with lacquer enamels or with paste pigments ground in japan. The fluid should be of very light body so that it can be applied in a fine mist coat. Effective color combinations include black on light green or red, gold on black, tan on ivory, green on natural light wood, dark blue on light blue, etc.

Jack Frost: "Jack-Frost" lacquers come in all colors, both opaque and transparent. The fluid is applied directly to bare wood, metal or glass. A fairly heavy coat works best. The texture starts forming about 2 min. after application and appears somewhat as shown in Fig. 12 although the exact pattern may vary considerably. The transparent finishes are especially effective on polished metals, glass

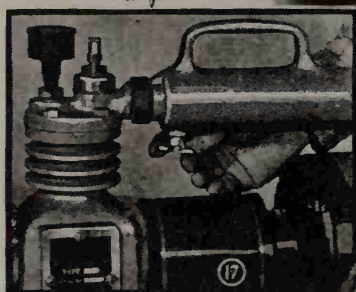




bottles Fig. 8, light bulbs and lighting fixtures.

Side Shading: An interesting effect on any raised finish is applied by spraying a contrasting color with the gun held almost parallel to the surface, as shown in Fig. 9. The job being worked in this picture is a wrinkle finish in bright green. The top color being applied is red, and, because of the position of the gun, the red color is deposited only on the sides of the wrinkles. The finished job appears green when viewed from one side and red when viewed from the opposite side.

Smutting: To add color and depth, smutting is commonly employed. A typical example is shown in Figs. 10 and 11. The project being finished is a cigarette box, which has been coated





Many interesting effects in wall treatment are possible with the use of plastic paint

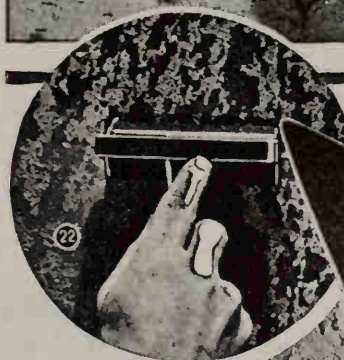
with red Jack-Frost lacquer. After this has dried, a smut is made by mixing paste pigments with japan or oil. Ordinary paint or enamel also can be used. A coat of the smutting color is applied, as shown in Fig. 10, and then immediately wiped off with a clean rag, as in Fig. 11, leaving the smut color in the depressed portions of the design.

Spatter: The familiar spatter effect is easily obtained by loading a large brush with the desired color and then striking it sharply against the hand to spatter the drops of color, as shown in Figs. 14 and 16. Similar effects can be obtained with a spray gun. For best results with a spray gun, pressure feed should be used. The paint should be of fairly heavy body, and the air pressure should be reduced greatly. On small spraying outfits, the reduction in pressure can be made by releasing the valve on the expansion chamber, as in Fig. 17. Contrasting color effects should be used on small areas, never for walls or other large surfaces.

Oxidizing: Imitation oxidizing, extensively used on metal products, is done by spraying black lacquer on polished metal, as shown in Fig. 18. A round spray pattern is required. Novelty effects using bronze powders mixed with bronzing liquid or clear or colored lacquers can be obtained easily. Where bronze powders are mixed with colored lacquers to secure a metallic effect, the proportions should be about one tablespoonful of powder to a pint of lacquer.

Dusting: In this process, the work is first coated with varnish. After the varnish has dried to a "tacky" stage, the top coating of bronze powder, pulverized felt, colored ground glass, etc., is sifted or dusted on. Figs. 15 and 19 show mica crystals being applied in this manner. Finish with a top coat of clear varnish.

Veiling: Giving the appearance of a string of color looped again and again on the surface of the work, veiling lacquers give an interesting effect, as shown in Fig. 13. Professional application requires a spe-



cial spray-gun nozzle, but a good novelty effect similar to spatter but with comet-like tails can be obtained by using this material in an ordinary spray gun.

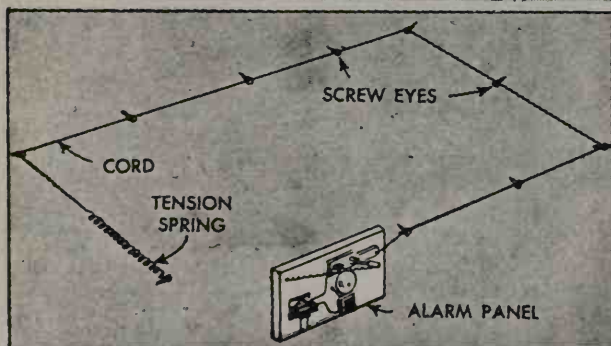
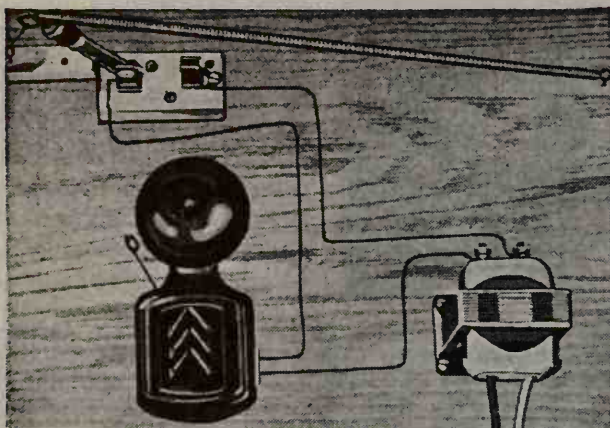
Plastics: Plastic paint is commonly used for wall surfaces, but can be applied to flower boxes, vases and other products where a rough texture is desired. It is of heavy body, and is best applied with a brush. After it has set up slightly, the material can be worked in a number of different ways to secure the desired texture. One method commonly employed is to use a wooden float, pressing this into the finish and then pulling straight out, as shown in Fig. 20. Other textures can be obtained with a stiff brush, crumpled newspapers or with a towel.

Spread-Spatter: An effective variation of spatter work is obtained by using plastic or other paint. This is spattered in the usual manner and when slightly set up is brushed lightly, as shown in Fig. 21. The example shows a two-tone spatter effect of light red and green over cream, the two colors being spread at right angles.

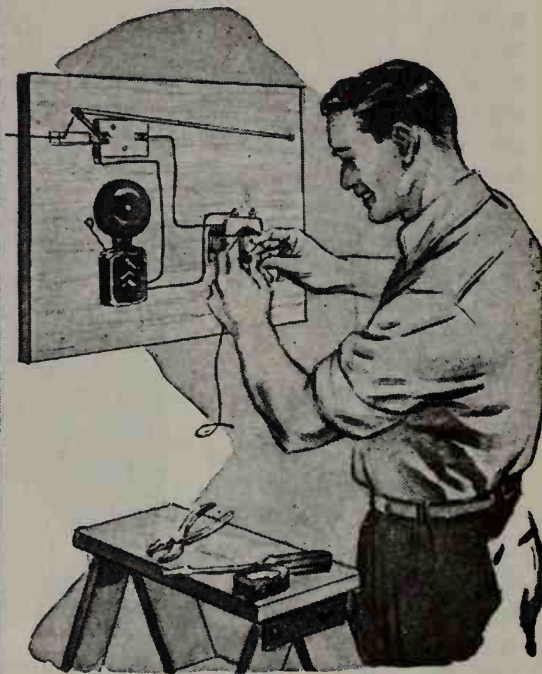
Caen-Stone: As shown in Figs. 22 and 23, Caen-stone effect is a popular wall finish secured by using plastic paint. It is applied over a smooth base coat. The top coat of the same or a contrasting color is applied by knifing the plastic in place, then leveling it smooth with a trowel. Two-tone effects in this and other troweled finishes can be obtained by applying the color coat of pigment with a rubber roller.

FIRE ALARM

Fire Alarm Rings When Retaining Cord Burns



Costing little, this fire alarm is simple, easy to make and install, and very effective, particularly for garages, barns and other outbuildings where a fire may not be detected instantly. The alarm consists of a doorbell wired through a transformer to a

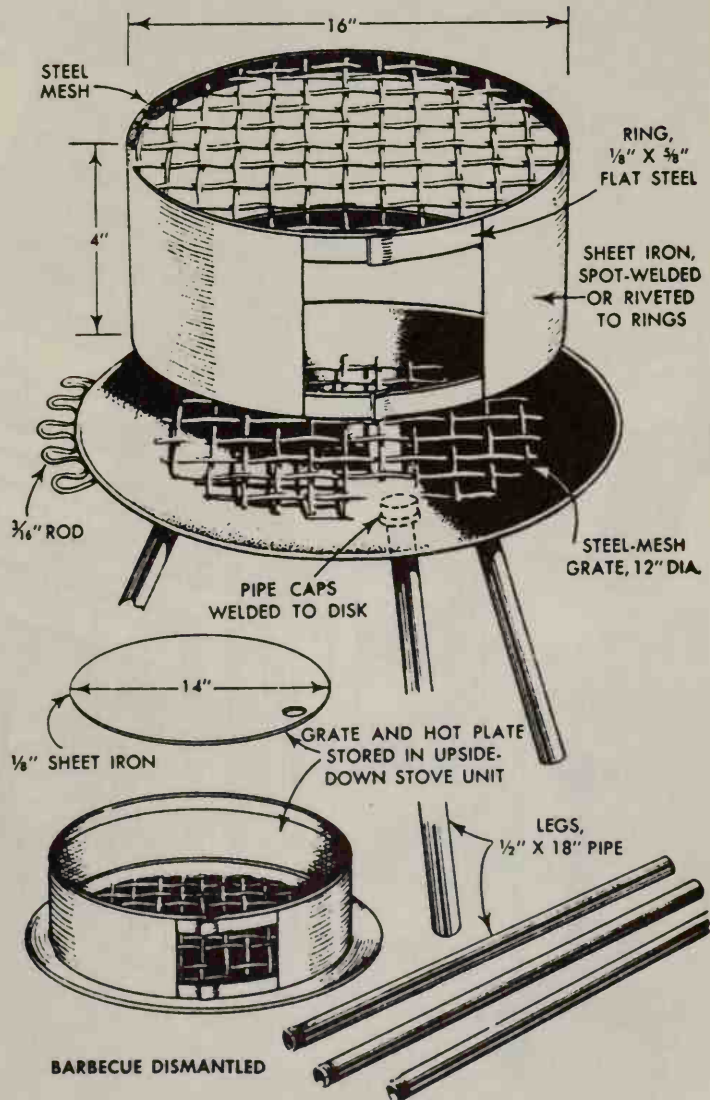


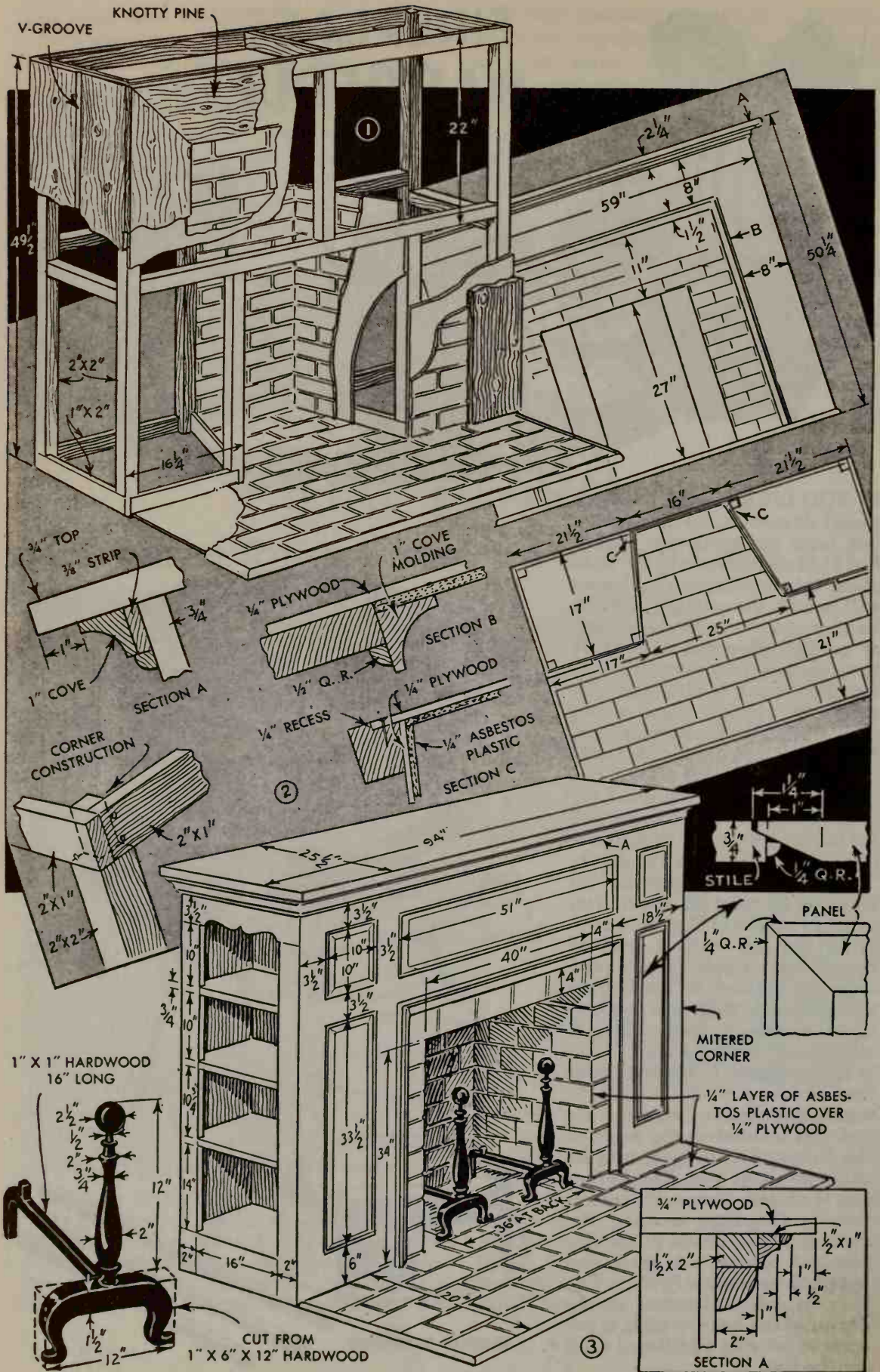
single-throw knife switch. The switch is held open by a screen-door spring attached to a length of cord, which is strung through screw eyes driven into the wall around a room and tied to the switch blade. Another spring of slightly less pull exerts tension to close the switch and cause the bell to ring when the cord is severed by fire. Bell will continue to ring until the alarm is answered.

FIREPLACE BARBECUE



IF YOU LIKE to cook an occasional dinner in the back yard but have no particular desire for a permanent outdoor fireplace, this knockdown barbecue will handle the cooking and can be tucked away in the basement or garage when not needed. It is set up in a minute or two and, being compact, is ideal for carrying on picnics. Steel scrap, pipe and an 18-in. harrow disk are used to make the unit, as detailed at the right. The 4-in.-deep firebox was designed for charcoal, but it can be adapted for burning wood by adding another 4 in. or so to its depth. The firebox is assembled by welding or riveting sheet iron to two flat-steel rings, and covering the top with a grid of heavy steel mesh. Three pipe caps are welded to the underside of the harrow-disk fire pan to take legs of $\frac{1}{2}$ -in. pipe. A steel-mesh grate, about 12 in. in dia., is placed in the bottom of the fire pan. A simple holder for roasting forks can be bent from rod and welded to the edge of the disk, and a hot plate may be cut from sheet iron. The barbecue is stored compactly by removing the legs, turning the firebox upside down in the fire pan and placing the grate and hot plate inside the firebox. The hole, which is located at the center of the harrow disk, is left open to provide additional draft for the fire.



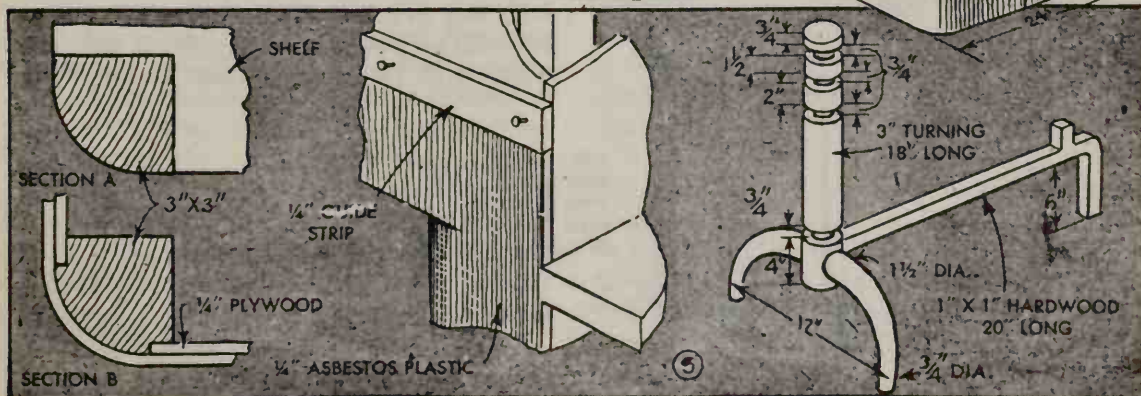
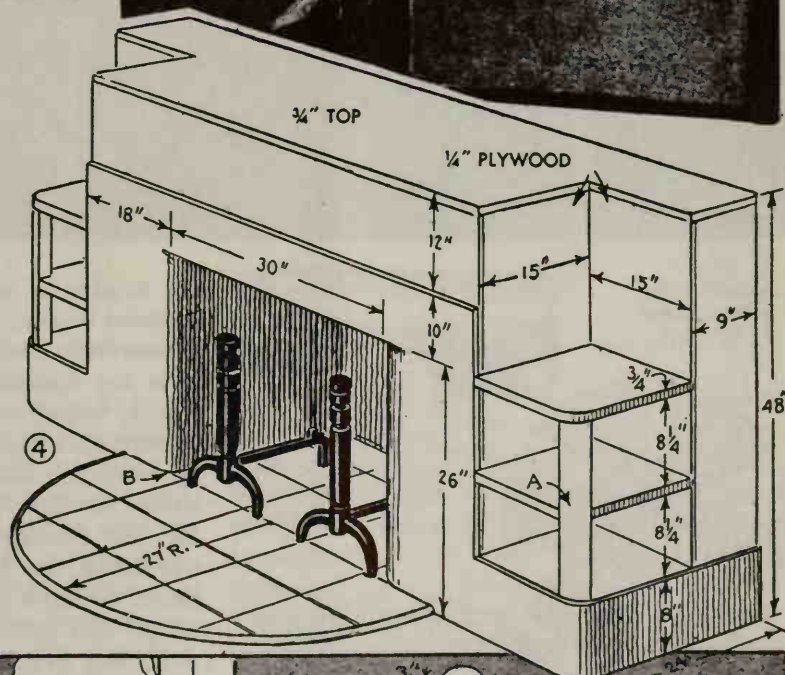


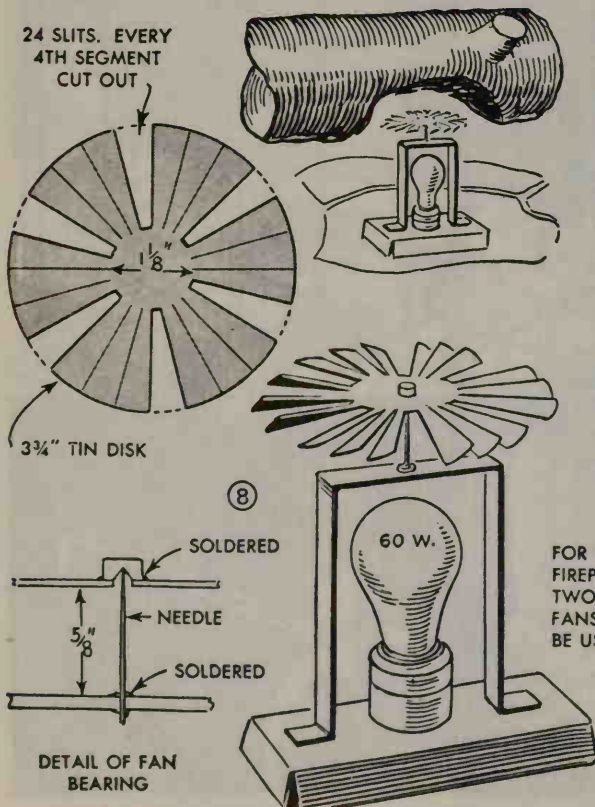
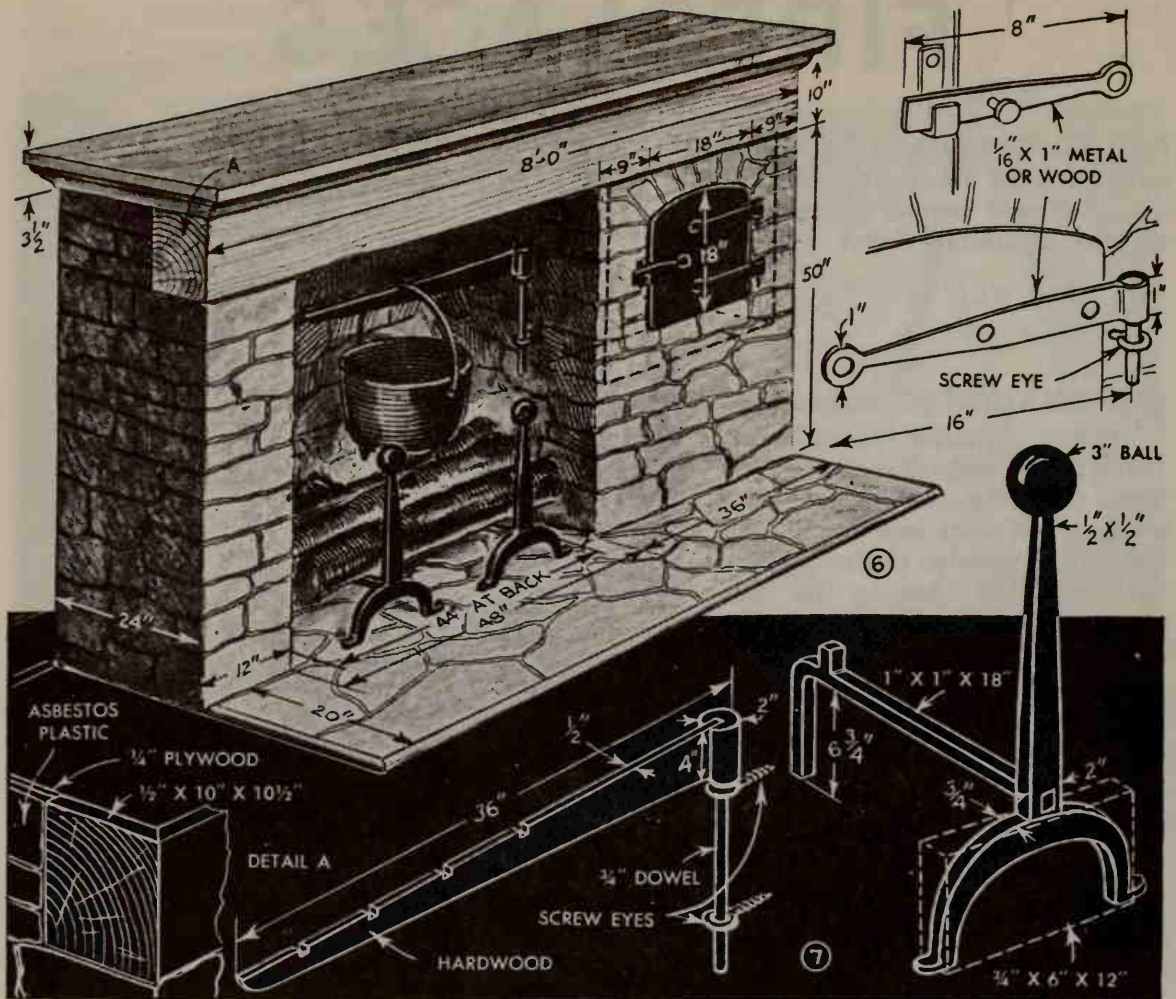
FIREPLACES

Four practical designs incorporating built-in book shelves and storage space. Plastic coating is applied and molded to imitate brick and stone

SO REALISTIC looking are these imitation fireplaces, you'll find it difficult to distinguish them from the real thing, especially when they are fitted with homemade wooden andirons and a "glowing" log. Among the four designs given there is one to suit practically any setting, from a modern living room to a den of knotty pine. The hearth of each is a separate unit from the rest of the fireplace for easy handling when moving.

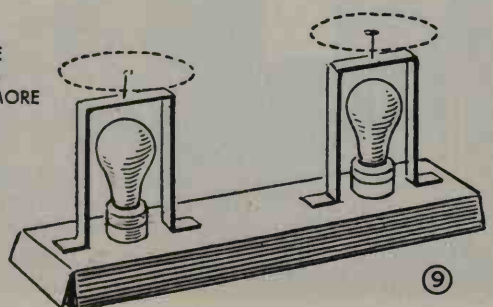
Construction is basically the same for all, that is, a rough framework similar to the one shown in Fig. 1, is made first, which is covered with plywood before adding the finished trim and the imitation brick or stone. Slight variation of this procedure will be noted in the construction of the modern fireplace detailed in Figs. 4 and 5, as no inner plywood covering is necessary here. In case you are unable to obtain $\frac{1}{4}$ -in. plywood, some of the bet-





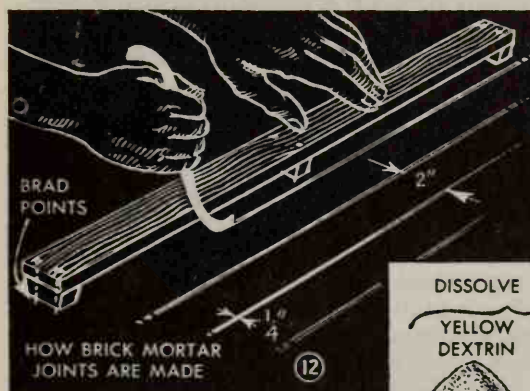
ter grades of wallboard, as well as hard-pressed board, will do. Figs. 1 and 2 detail a neat little fireplace that is especially suitable for apartment use, while the one in Fig. 3, being considerably larger, requires a more spacious setting. Plain stock, painted to match the woodwork, can be substituted for the knotty-pine trim suggested for the former. The trim on all should overhang the frame about $1\frac{1}{2}$ in. at the back, to have sufficient stock from which to cut out around the baseboard. To look well, the fireplace should fit as snugly to the wall as possible. A length of flat-wire solder will be found handy in obtaining

FOR LARGE FIREPLACES TWO OR MORE FANS CAN BE USED

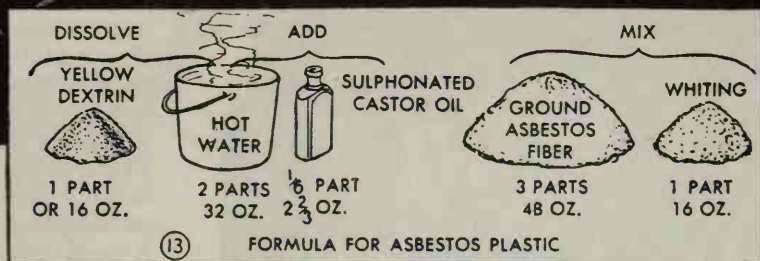
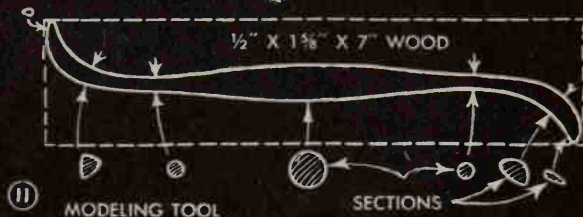


the shape of the baseboard for transferring to the end boards. Areas to be covered with plastic should have $\frac{1}{4}$ -in. wire mesh tacked to them to make it adhere. However, if you are unable to obtain this material, another way to key the plastic is to groove the plywood deeply with a sharp tool, undercutting the grooves thus made, then size the wood with a coat of shellac.

Now to mix and apply the plastic: The ingredients of this are listed in the formula given in Fig. 13. Weigh and measure these carefully, and when adding the asbestos-whiting mixture, stir constantly and finally knead with the hands. Be careful not to add more water than is specified. A pail is a good container in which to mix and store the plastic. It can be kept for as long as a



In "raking" brick mortar joints, divide the space evenly so that all courses will be a uniform width of about 2 in.



month if covered with wet cloths to prevent it from drying out. Apply the plastic with the fingers or putty knife, pressing it into the wire-covered surface, and build up a layer about $\frac{1}{4}$ in. thick. Then smooth it lightly with a trowel dipped in water frequently. Avoid troweling the plastic too smoothly in order to have the texture resemble that of brickwork. To simulate stone as is used on the colonial fireplace detailed in Figs. 6 and 7, a wooden modeling tool like the one in Fig. 11 is needed to form the "mortar joints." This is used free-hand as in Fig. 10 to produce irregular joints, but it is run along a straightedge as shown in Fig. 12 for producing brickwork effects. Where a rough stone effect is wanted, build up the thickness of the plastic by adding a second layer. The plastic dries hard in 48 hrs., the same color as cement.

Artists' oil colors, thinned with turpen-

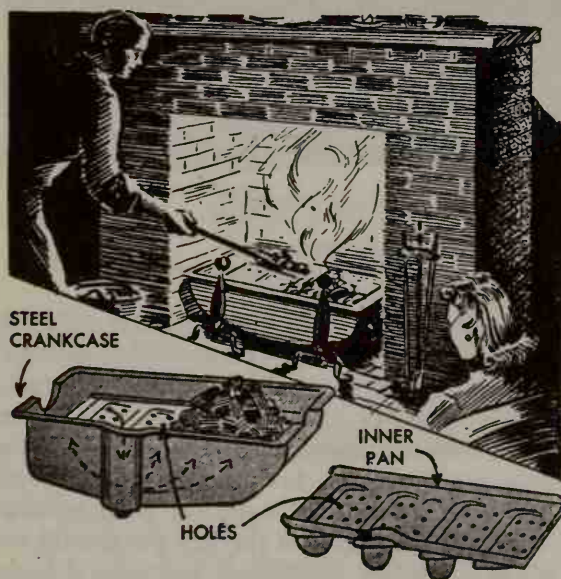
tine, are best to tint the plastic. Burnt sienna, Indian red or Venetian red, with or without lampblack added, will give practically any brick shade wanted. Apply a wash coat of this, leaving the mortar joints unpainted. Then tone individual bricks here and there a little darker than others. The back and sides of the fire pit should be given a coat of lampblack to make it look smoked. Stone surfaces require more care in coloring. Experiment with yellow, blue, green or orange colors mixed with sepia or raw umber to obtain the stone effect.

A log charred on the underside by applying a blowtorch or other flame to it, and placed over a hidden colored bulb as shown in Figs. 8 and 9, will give a flickering glow to further add realism. Also, by "peening" the wooden andirons and giving them a coat of flat-black paint, it will be hard to tell them from iron.

FIREPLACE

Coal Fireplace Grate Improved From Auto Crankcase

A fireplace grate that will give good service can be made easily from an old auto crankcase. One from any four-cylinder motor will fit most fireplaces, and can be obtained from a wrecking yard at a small cost. A model-A Ford crankcase is easy to alter for the purpose. Merely pry out the inner pan or partition containing the bearing troughs and punch a number of holes in it as indicated to permit entrance of air under the fuel. Replace the pan and remove the plate over the oil pump, which will permit air to enter the crankcase un-



der the perforated pan when the case is set on the andirons. Before using the grate, however, it is a good idea to burn off all the oil and grease so that there will be no odor when the fireplace is put into use. If another type of crankcase not having an inner pan is used, it may be necessary to punch holes through the sides to provide a draft. You can do this with a cold chisel, making the holes about an inch square. Be sure to provide good support under the metal when punching the holes, otherwise you likely will dent and misshape the grate.

Easily carved in soft pine with a jackknife

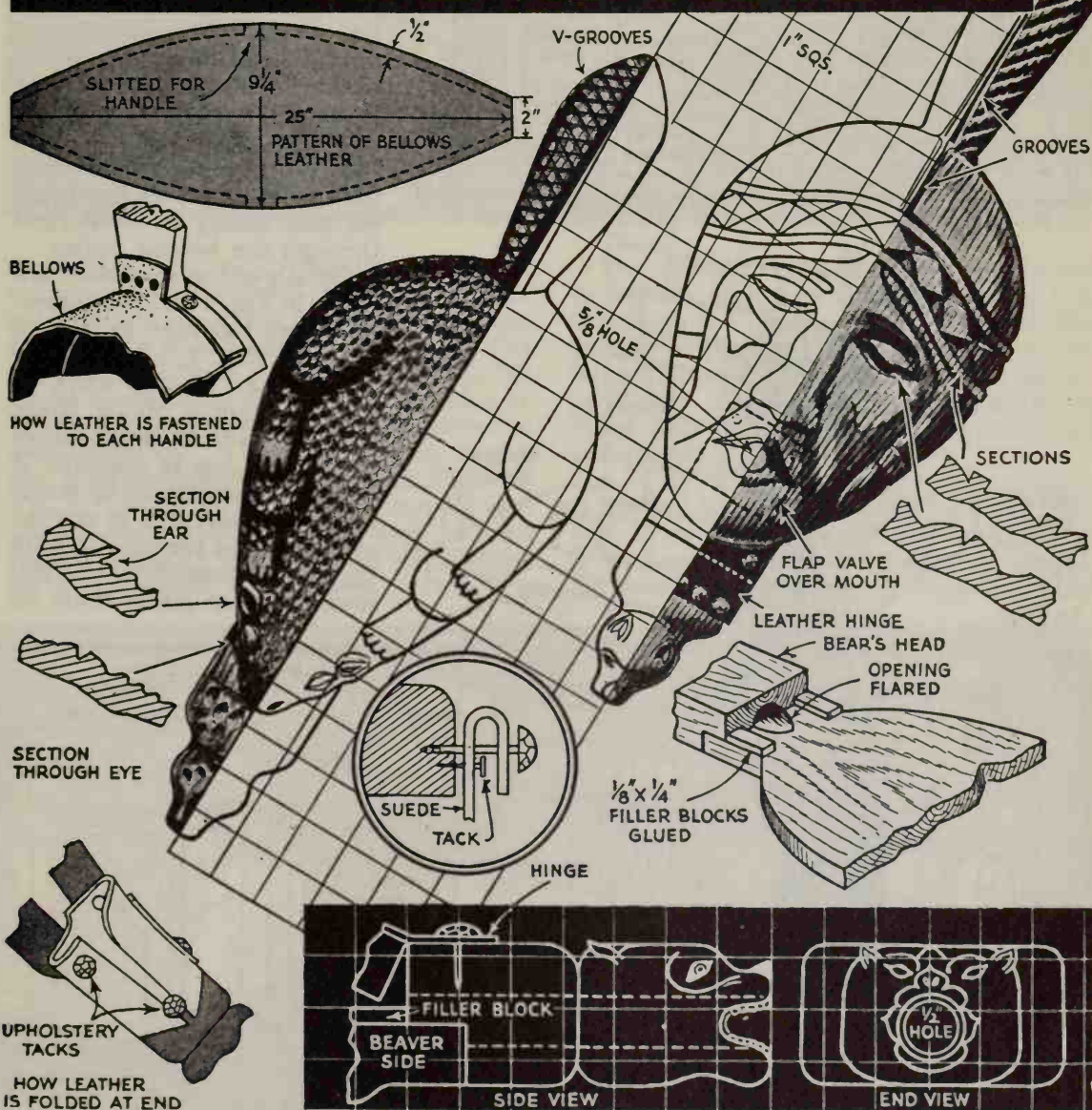
REMINISCENT of colonial days, this novel bellows with its carved Indian head and beaver pelt is especially in keeping with a colonial fireplace. The design incorporates the beaver's tail and the head-dress feather as handles, and the Indian's mouth is puckered to appear to be blowing although the air actually comes out through the mouth of a carved bear head fastened to the lower end. Both sides of the bellows are cut practically alike, the Indian side being a little wider at the neck and the pelt side about $\frac{1}{2}$ in. longer to stagger the hinge joint and also to extend into a rabbet cut in the bear's head. A piece of 1 by 8-in. white-pine shelving is excellent to carve the sides from and if it contains a knot or two, so much the better. Both feather and tail are tapered from the center to the sides and all other edges are rounded. A $\frac{5}{8}$ -in. hole forms the Indian's mouth, or air inlet, and is covered on the back with a flap valve which is simply a square piece of thin leather tacked to the upper lip with two tacks. The hole through the bear's head where it joins the sides should be hollowed out or flared as shown in the detail to assure a good entrance to the outlet.

Carving is done in very low relief, consisting largely of V-grooves made with a pocket knife. Rib cuts in the feather, the markings on the tail and toes and the eye openings are made smaller than the other cuts. The photo and sectional details will show you the right contour to duplicate. Fur is simulated on the beaver pelt by countless small gouge cuts made over the whole surface, except the paws. To compensate for the two small filler blocks glued to each side of the flared opening, the Indian's neck is whittled down at this point to fit flush with the bear's head.

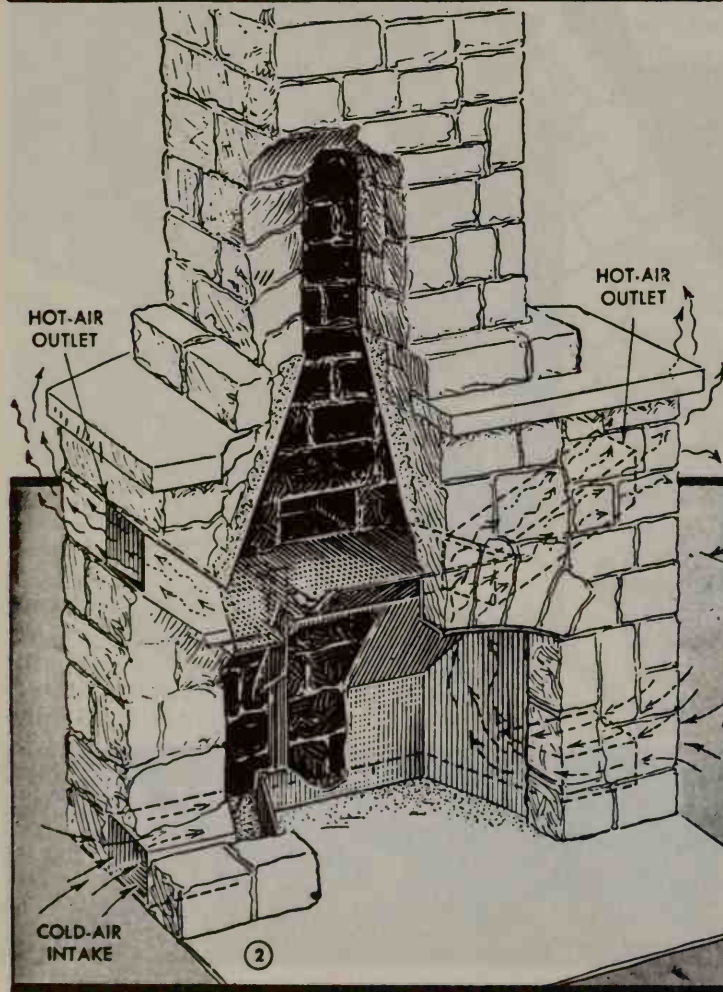
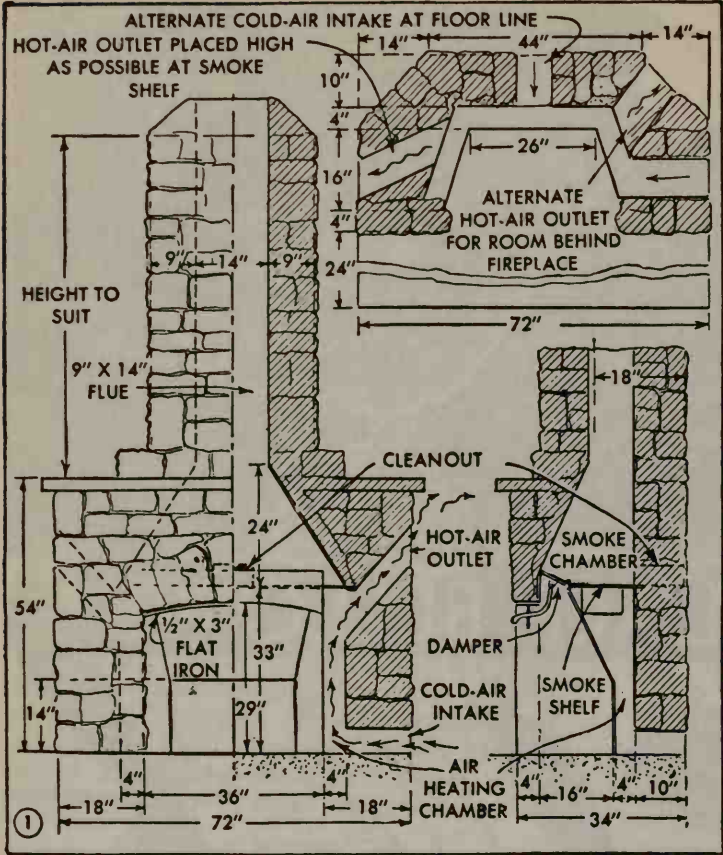
Suede is best for the bellows, but imitation leather or canvas, if available, can be used, although the latter will have to be sealed with paint or oil. The details show how the leather is tacked to the sides and handles with plain tacks spaced 1 in. apart, after which the edges are folded back about $\frac{1}{2}$ in. or so and held with ornamental upholstery nails spaced about 2 in. apart.



Carved FIREPLACE BELLOWS

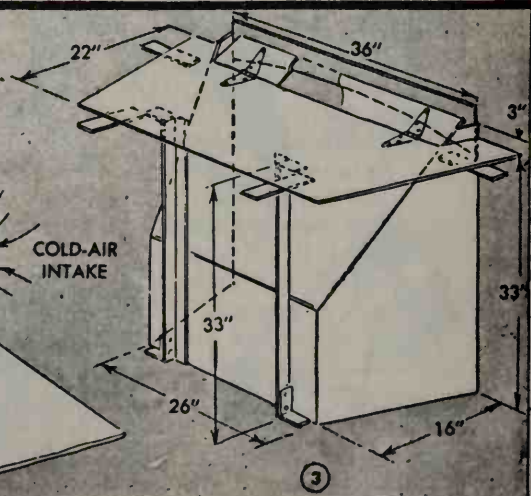


FIREPLACE



THERE'S no need to worry about chilly evenings at your cottage or camp if you have this circulating fireplace. It's also equally effective in your home for cool evenings during late spring and early fall so you won't have to start the heating plant. And during the winter it will lessen the load on your furnace considerably on extremely cold days. Because it recirculates the air instead of sending most of the heat up the chimney, this fireplace is an efficient unit. The path which the air follows is shown in Fig. 2; it enters the cold-air intake, passes through the space formed by the metal shell and the masonry, where it is heated, and finally is discharged through the hot-air outlet.

Details of the steel shell are given in Fig. 4 and the assembled unit appears in Fig. 3. Plate E, Fig. 4, which is the main part of the unit, is formed from a 36 by 60-in. piece of No. 12-gauge sheet metal. No lap is required if the unit is assembled by welding. However, if it is riveted or bolted, the lap indicated by the dotted lines should be followed. These joints must be



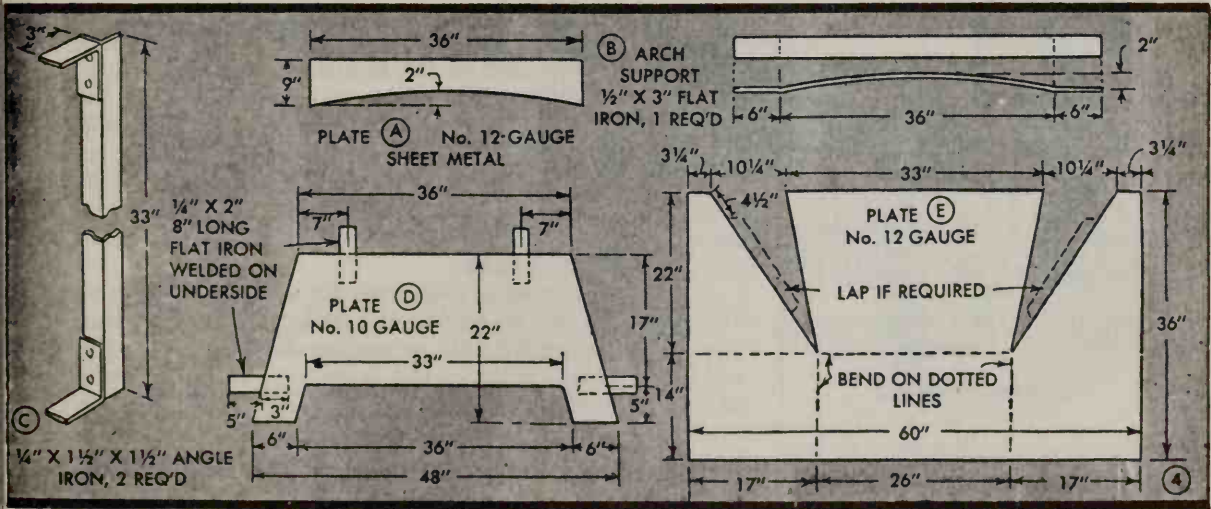
CIRCULATES WARM AIR

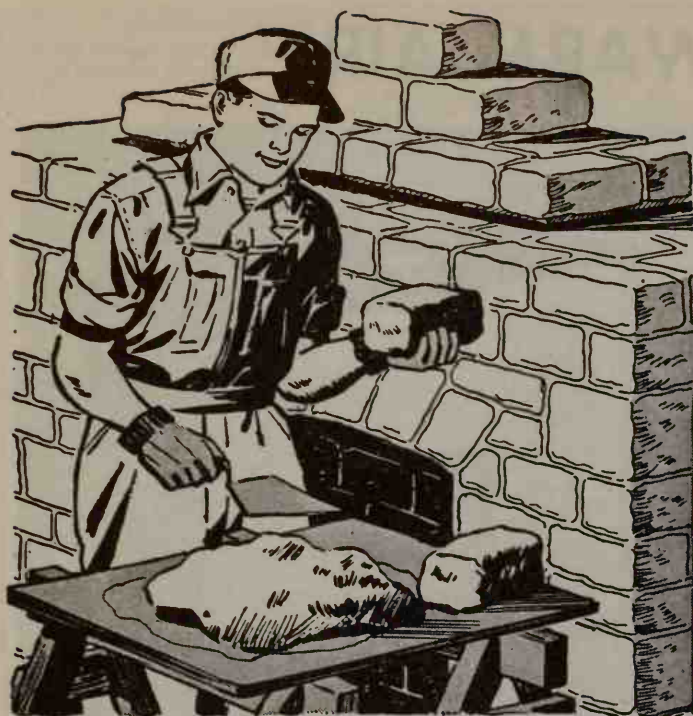


smoketight and may require the use of furnace cement. Plate A, Fig. 4, is cut from a 9 by 36-in. sheet and is hinged to the top front of the shell to act as a damper. The smoke shelf, Plate D, is a piece of No. 10-gauge metal 22 by 48 in. This is welded or bolted to the shell, Fig. 3, and supported at the rear by two $\frac{1}{4}$ by $1\frac{1}{2}$ by $1\frac{1}{2}$ -in. angles cut and assembled as shown in Plate C, Fig. 4. The edges of this plate are set into the masonry about $1\frac{1}{2}$ in., and, to give further support, flat-iron lugs are welded to the underside of the shelf.

The damper control, lower right-hand detail, Fig. 1, is a piece of flat iron cut in the shape of a gooseneck and hinged to the damper. Adjustment of the damper is obtained by engaging notches in the gooseneck with a catch set in the masonry. A $\frac{1}{2}$ by 3 by 48-in. bar is used to make the arch, Plate B, Fig. 4.

A stone, rubble and concrete foundation is carried to solid ground below the frost line. If the house has a basement, the floor is broken up and the foundation carried down in the same manner. When the foun-





dation has been completed to the level of the hearth, the steel shell is set in place. The masonry is built up 4 in. away from the sides and the back of the shell, with the smoke shelf, as mentioned previously, sealed into the stonework. When building the masonry, allow for cold-air intakes at the bottom, Fig. 2. The hot-air outlets are slanted upward, beginning under the smoke shelf. These are either standard 6 by 8-in. ductwork or 7-in. stovepipes. Besides the outlets shown in Fig. 2, additional outlets are suggested in the upper right-hand detail of Fig. 1. This would apply when the fireplace is not against an outside wall and it is desirable to heat a room at the rear of the unit. For every outlet installed there is a cold-air intake.

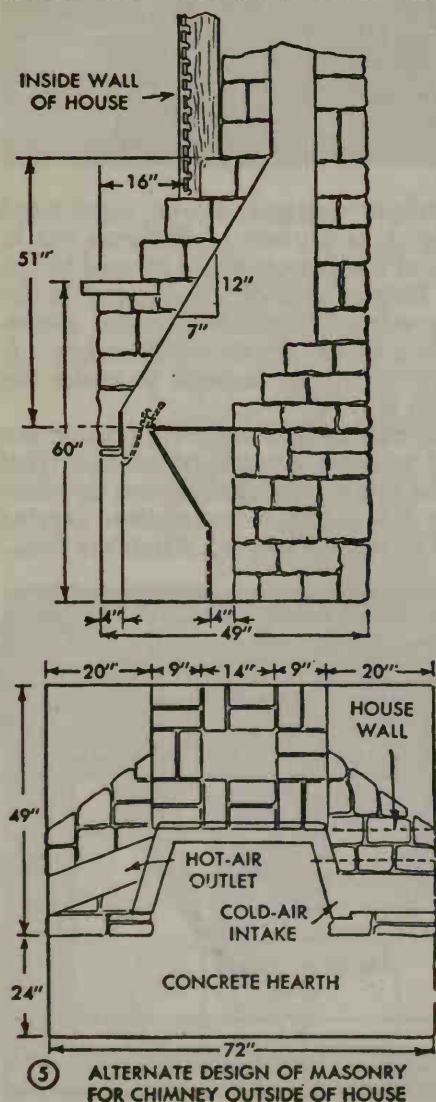
However, before the outlets are completed, the arch bar, Plate B, Fig. 4, is installed. This is done when the masonry has been carried

to the height of the damper. The smoke chamber part of the flue has a slope of about 60 degrees. It is built around a wooden frame which is knocked down and removed before the chimney is built. No attempt should be made to burn the frame out. The inside dimensions of the flue are given as 9 by 14 in., but these dimensions can be varied somewhat as long as the cross sectional area is over 100 sq. in.

Fig. 5 shows an alternate masonry design when it is desirable to have the chimney outside the house. This avoids cutting out a portion of the wall and roof of the house, but requires wider and heavier masonry at the base and a higher smoke chamber to obtain the proper bevels. In this case, since the chimney is not seen from inside the house, it can be built of brick.

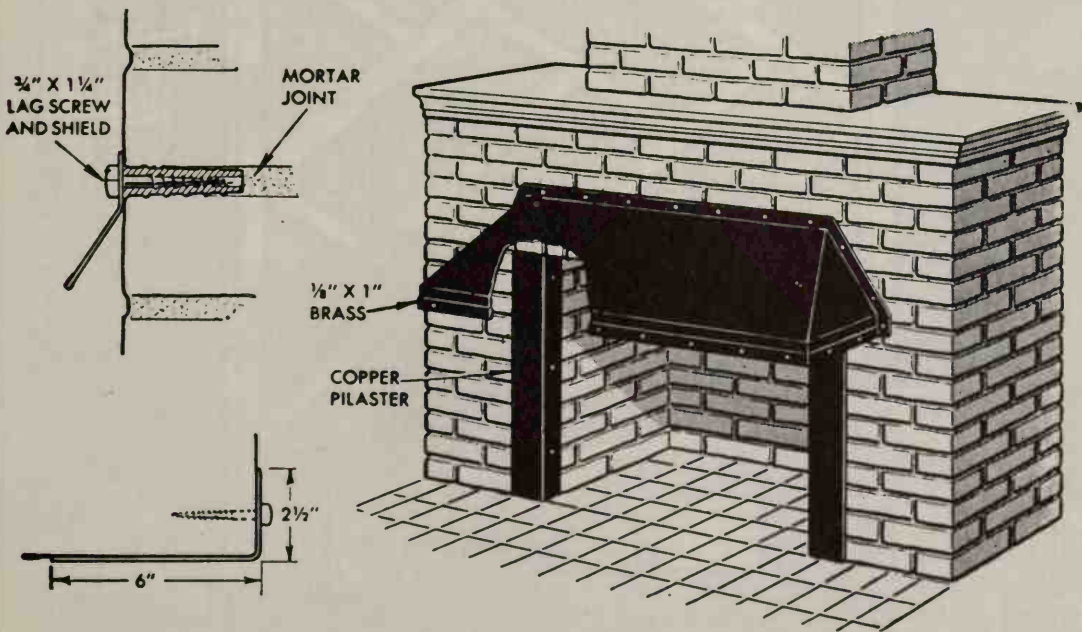
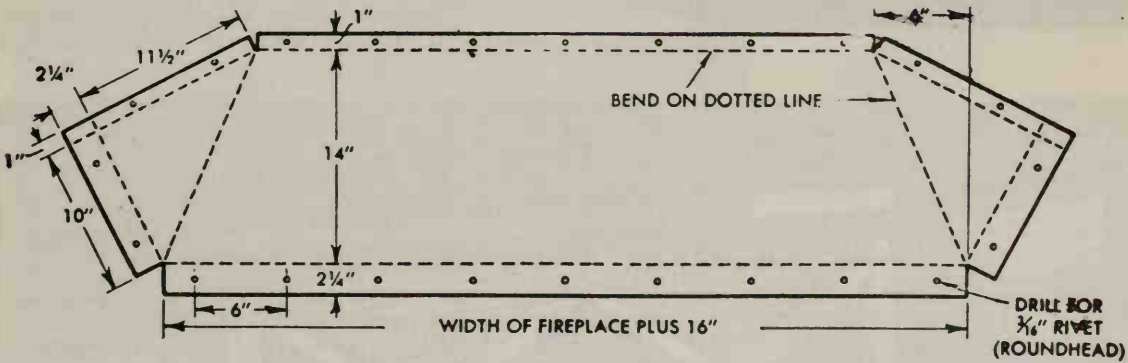
There are many refinements and conveniences that may be added to this basic fireplace. A cleanout door can be located above the smoke shelf at the back of the fireplace so that accumulations of soot can be cleaned out from time to time. It is important that this door be a tight fit; otherwise it will interfere with the draft action of the chimney. A short length of galvanized duct the same size and shape as the flue, with a conical or pyramid-shaped rain cap, will prevent mice, squirrels and other rodents from running up the masonry and down the chimney. With this cap it also will be unnecessary to board the chimney over if the cottage is to be left unoccupied for any length of time.

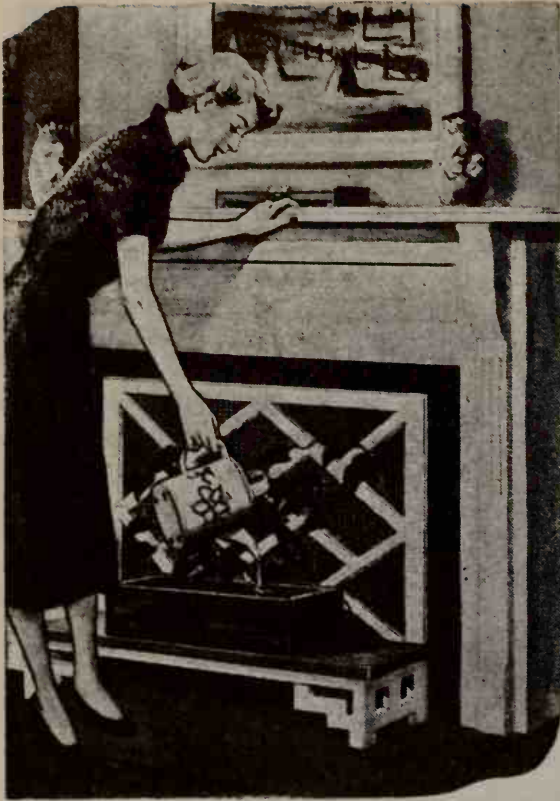
Other attachments that may be added to improve the appearance and add to the utility of the fireplace include a swinging arm or crane. This is set in the masonry at the front of the fireplace. A metal oven which extends through the stonework above the smoke shelf will provide for some Dutch oven style baking. Other accessories such as revolving spits for barbecues and hot-water heating coils will add to the usefulness of the fireplace.



FIREPLACE HOOD

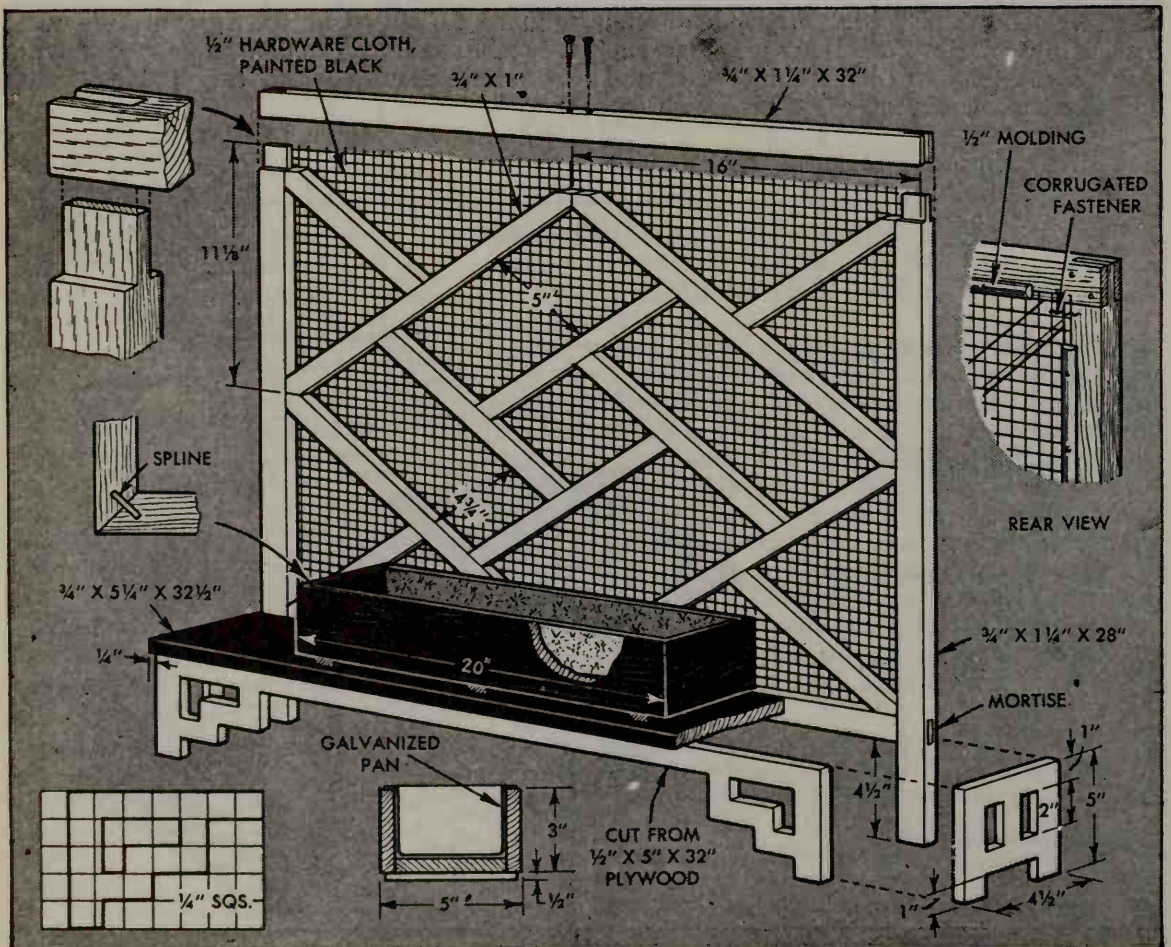
MADE of gleaming burnished copper, this attractive hood adds a Western touch to the front of a plain brick fireplace. Installation of the hood makes the opening appear lower and therefore wider, resulting in a more pleasing over-all appearance. Sheet copper is cut to the dimensions given in the detail. Note, however, that the length of the hood is not listed, as this must be determined by adding 16 in. to the width of the fireplace opening. The sheet is drilled for rivets and lag screws and then bent along the dotted lines. The top edge is rounded at the corners by brazing pieces of scrap copper to fill the notches opposite the bends, and then a $\frac{1}{8}$ x 1-in. brass strip is riveted to the bottom edge. The completed unit is mounted on the fireplace by driving lag screws into lead shields inserted in the mortar joints as in the center detail. If desired, copper pilasters may be attached to the corners of the fireplace opening.



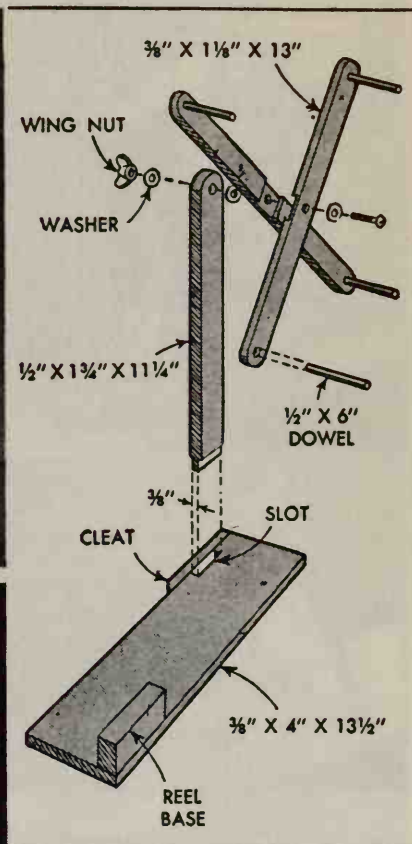
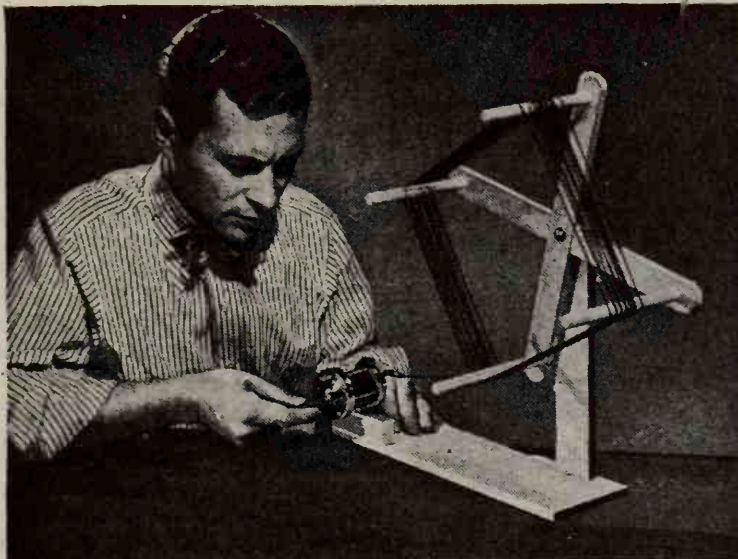


FIREPLACE SCREEN

FROM a decorative standpoint, the blackened interior of an unused fireplace is an eyesore, especially during spring and summer months when color is necessary to give a new lift to old surroundings. That's when you need this attractive trellis "fire screen" to camouflage the opening. Chinese in motif both in color and design, the screen, when augmented with a growing or artificial vine, provides a smart summer treatment for an uninviting fireplace. The outer framework of the trellis is mortised at the corners. Then the diamond shape in the center is fastened with long screws and the remaining parts with corrugated fasteners. The back of the trellis is covered with hardware cloth which is painted black to contrast with a Chinese-red framework. The base and shelf of the screen are cut from plywood, and the wooden flower box, mitered and splined at the corners, is fitted with a copper lining. The flower box and shelf are painted black to set off the red.



FISHLINE DRIER



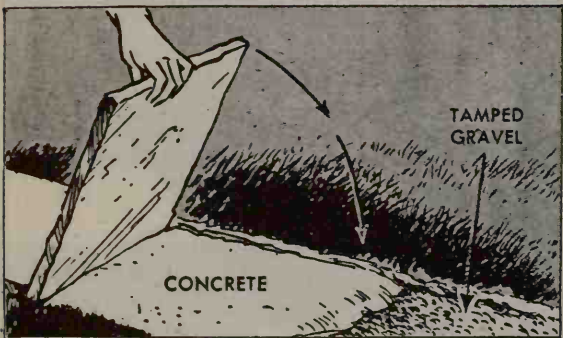
To fishermen who take special pride in having tackle always in perfect condition, a line drier is a "must" item of equipment. This one is made entirely of hardwood and the take-apart design permits it to be stored in a small space when not in use. It can be set up in a jiffy. The reel spider turns on a simple bearing on which tension is adjustable by means of a wing nut, permitting just the right drag on the line when rewinding to the reel. Reel arms can be lengthened to 8 in. if desired. Finish the parts with spar varnish



FLAGSTONE CASTING

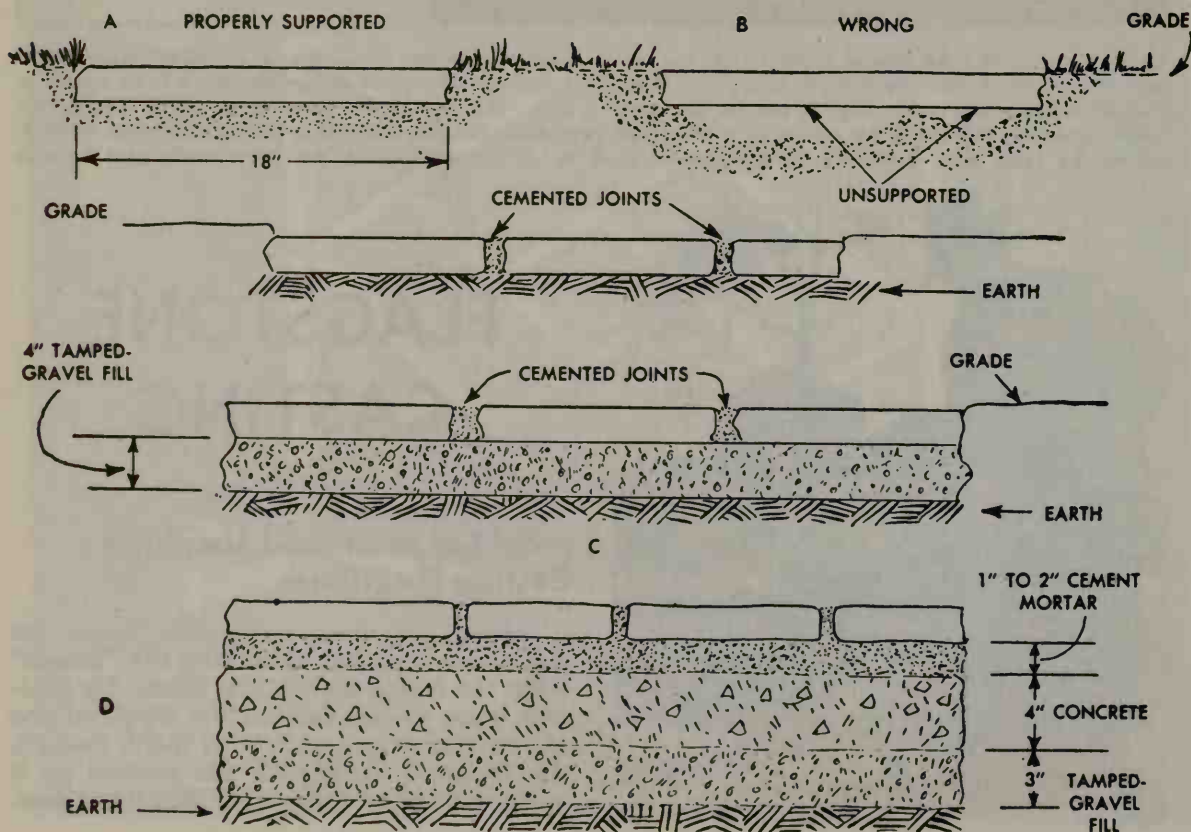
Mold Cut in Ground Simplifies Casting Flagstones

Instead of making regular forms for flagstones and then removing the "stones" from the forms and setting them, dig shallow holes in the ground the shape of the stones and pour concrete in them. Smooth the concrete flush with the ground so it will be easy to mow over the flagstones.



FLAGSTONE LAYING

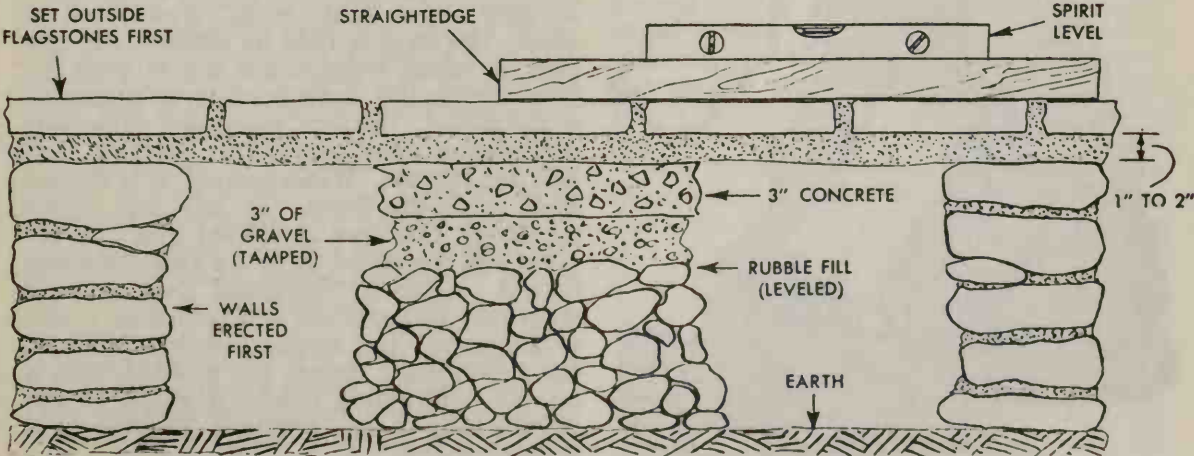
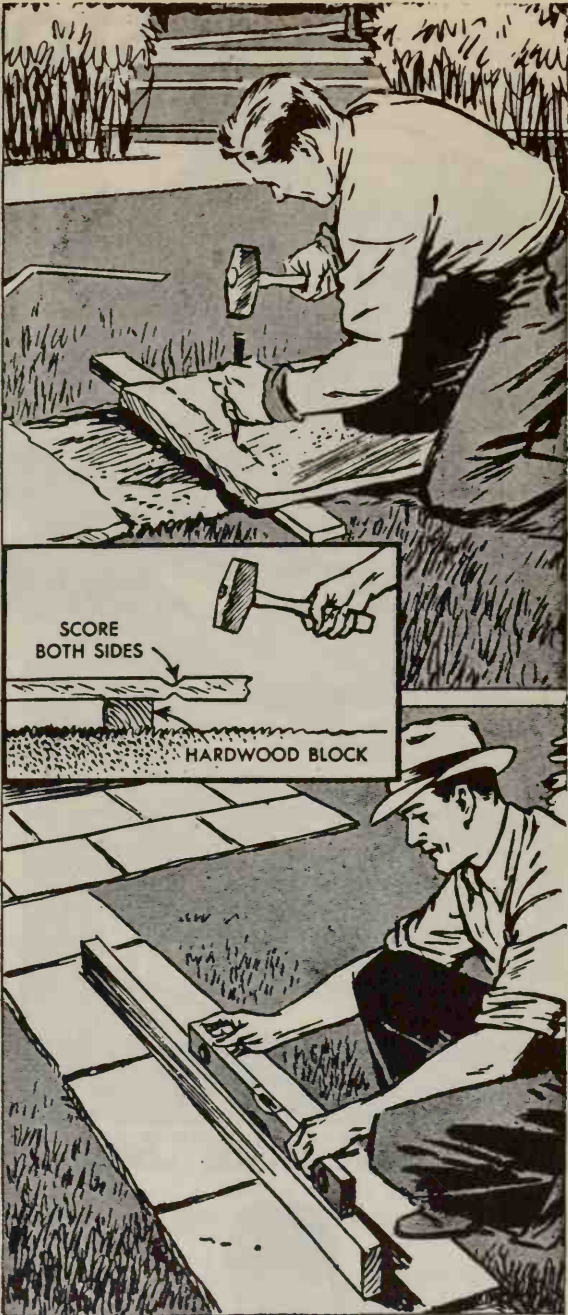
LAYING FLAGSTONES is a natural for amateur stonemasons as there are no tricky corners to plumb and no mortar thicknesses to watch as in laying up a wall. The random patterns formed by simple stonework are what make flagstone walks, patios and driveways so very attractive. There are several methods of laying flagstone where only one layer, or course, is used. The first and simplest, is shown in detail A in the drawings below. Earth is excavated to a depth equal to the thickness of each individual stone and the recess is cut to a size and shape that will take the stone in a snug fit. In an area where the soil is firm and the drainage adequate this method is satisfactory, but it cannot be recommended as permanent construction. It is important to smooth the bottom of the excavation so that the stone is fully supported. If the bed of the excavation is uneven, portions of the stone will be unsupported as in detail B. This will cause the stone to tip sidewise. Some builders prefer to lay the stones edge to edge in a continuous excavation; the spaces between the in-



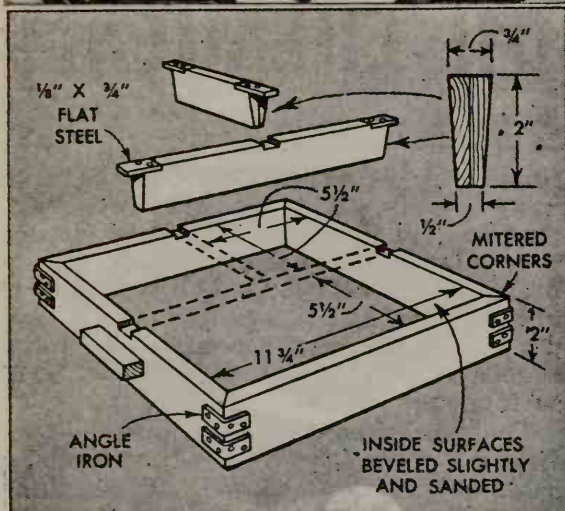
dividual stones being filled with cement mortar. The best and most permanent construction of a flagstone walk is shown in section in detail C. on the opposite page. Here a continuous excavation is made to the width required and to a depth equal to the average thickness of the stones plus an additional 4 in. for a tamped-gravel fill. After the gravel has been thoroughly tamped with a special tamper as in the upper illustration on the opposite page, the stones are selected and laid in cement-mortar joints. Some builders spread a 1-in. layer of concrete over the gravel as in the center illustration on the opposite page.

One approved method of driveway construction is shown in detail D. Depths given for the gravel fill and concrete slab can be varied to suit local conditions. The thickness of the concrete may be increased to 5 in. and the gravel fill to 6 in. where drainage and service conditions require greater support.

Patio construction is shown in the sectional view below. Walls always should be laid up first. On soft soils the walls should be placed on adequate footings but on gravelly soils and clay soils footings will not be required unless the walls exceed 12 in. in height. The structure consists of enclosing walls, a fill consisting of rubble, tamped gravel and concrete. After this is fully cured the flagstones are laid in cement mortar and the joints filled as indicated. Use a straightedge and builder's level to determine the necessary slope to shed water and to assure that the surface is fairly uniform. Flat stones can be cut to any size desired by scoring both sides with a chisel. To break the stone after scoring, support it on a wooden block and strike the surface lightly near the scored lines as in the upper right-hand detail. Stonemasons use various methods of breaking stone but this procedure is fairly reliable with large flat stones.



FLAGSTONE MOLD

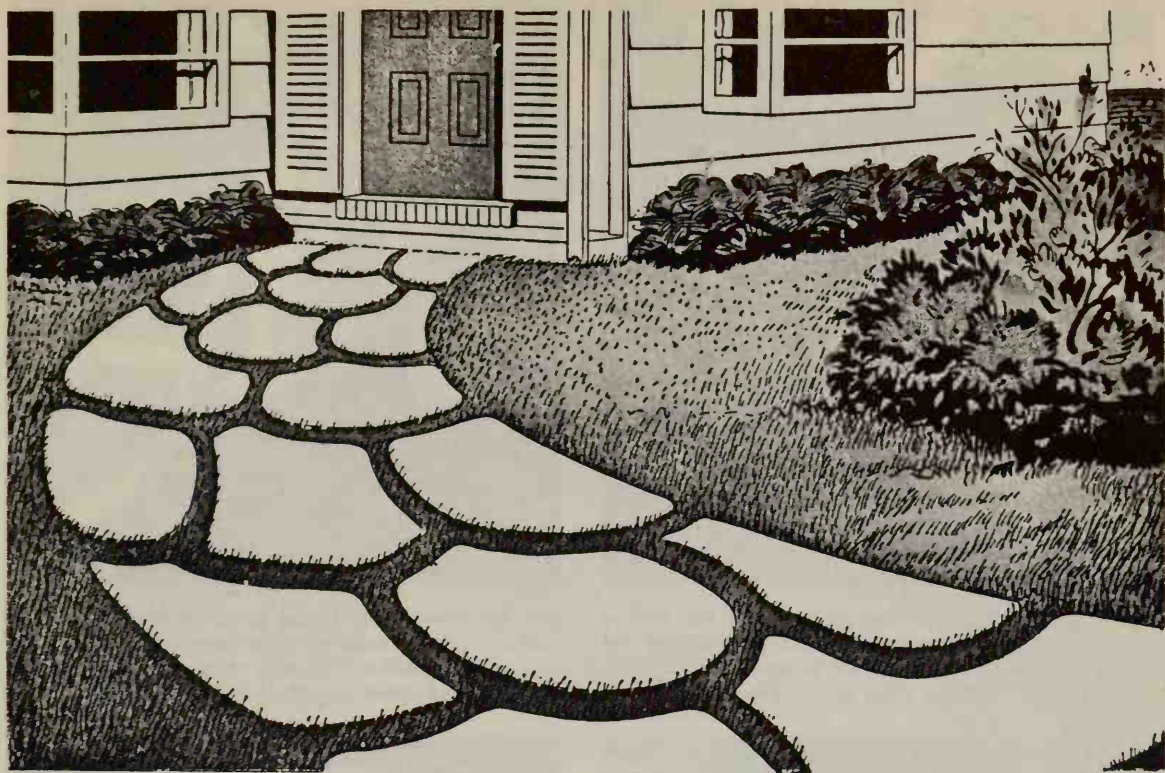


FITTED WITH REMOVABLE dividers for making flagstones in three sizes, this simple mold will enable you to work out a variety of interesting patterns when laying out a walk or terrace. The frame is $\frac{3}{4}$ -in. stock, mitered at the corners and assembled with steel angle irons. Each divider may be two thin pieces joined together to prevent warping that are beveled and later oiled for easy removal from the concrete. The concrete consists of cement, 1 part, clean dry sand, 2 parts, and pea gravel, 3 parts. While curing, the blocks should be covered with burlap or a tarpaulin and sprinkled periodically. To provide drainage, the blocks are laid so they project $\frac{1}{2}$ in. aboveground.

Sheet-Metal Strips Used for Casting Cement Flagstones



Artificial flagstones of any shape, size and color can be made by using a strip of thin sheet metal as a form, filling it with cement and troweling in colored oxides. The strip, which can be taken from a packing case or cut from light sheet stock, need be only about $\frac{3}{4}$ in. wide. When bent to shape, the strip is held by sheet-metal fingers on which weights are laid to keep the form flat on the work surface, as indicated in the detail. The mix, composed of cement and plaster sand, should be medium rich and not too wet. When poured, it is floated flush with the form. To use the oxides sparingly, they are sprinkled over the cement and trowelled in with a steel finishing trowel. After a "flagstone" has set, the strip may be removed and reformed to another shape. The stones then are laid and the intervening spaces are pointed with a mix of contrasting color. A space of approximately 1 in. between flagstones is recommended.



Pour Your Own

FLAGSTONE WALK

WHY PAY OUT a lot of money for flagstones when you can cast them realistically in concrete? It requires no special skill. A trowel and a shovel are the principal tools needed and the work is actually fun. The series of photos on the opposite page take you through the steps involved and illustrate convincingly what a simple job it is. The "stones" are cast right in place, using metal molds resembling large cookie cutters. The molds are bands of sheet metal which are bent into irregular shapes to closely resemble actual flagstones. These are fitted together like the pieces of a puzzle, being spaced about 2 in. apart and held in position with dampened soil. After each stone has been cast and allowed to set 24 hrs., the molds are removed and reused. The first thing to do is to lay out the width and desired curve of the walk, using a garden hose to establish its outline. Small stakes are driven along the outside of the hose and used to guide the placing of the molds. If a lawn already exists where the walk is to be located, the sod is removed to a depth of about 1½ in. Take out only enough sod to accommodate the number of stones to be laid at one time. In this way, the walk can be built in stages

to suit your spare time without having the lawn torn up. The molds consist of sheet-metal strips 2½ in. wide and 5 or 6 ft. long. The ends of each mold are wired together through holes punched in the metal with a nail. Keep the molds large and varied in shape, no two being alike nor smaller than 1½ ft. across.

A 1-2-3 mix is recommended for the concrete fill, that is, one measure of portland cement, two of sand and three of pea gravel. Tamp the concrete firmly in the molds so that it puddles at the top and then rake off any surplus flush with the top of the molds, using the edge of a straight board. A little crown is preferred in troweling the stones so that they will shed water. Avoid using an edging tool around the outer edges of the molds. It is better to let the mold chip the edge of the concrete as it is removed so that it resembles a regular hand-cut flagstone. The molds usually can be removed the following day by merely cutting the wires that hold them together. After the metal bands have been pulled free, some of the dirt is scooped out from between the stones and replaced with strips of sod, keeping the latter lower than the tops of the stones.



1st. A garden hose is used to establish the outline of the walk. This is staked in position and then the sod is removed, some of which is saved for filling in around the flagstones after the molds are removed



2nd. The sheet-metal bands which form the molds are made "endless" and then bent into irregular shapes, no two being alike. The ends of the bands are wired together and molds are placed as desired 2 in. apart



3rd. Wet soil is used to hold the molds in position. Part of this is later removed and replaced with sod



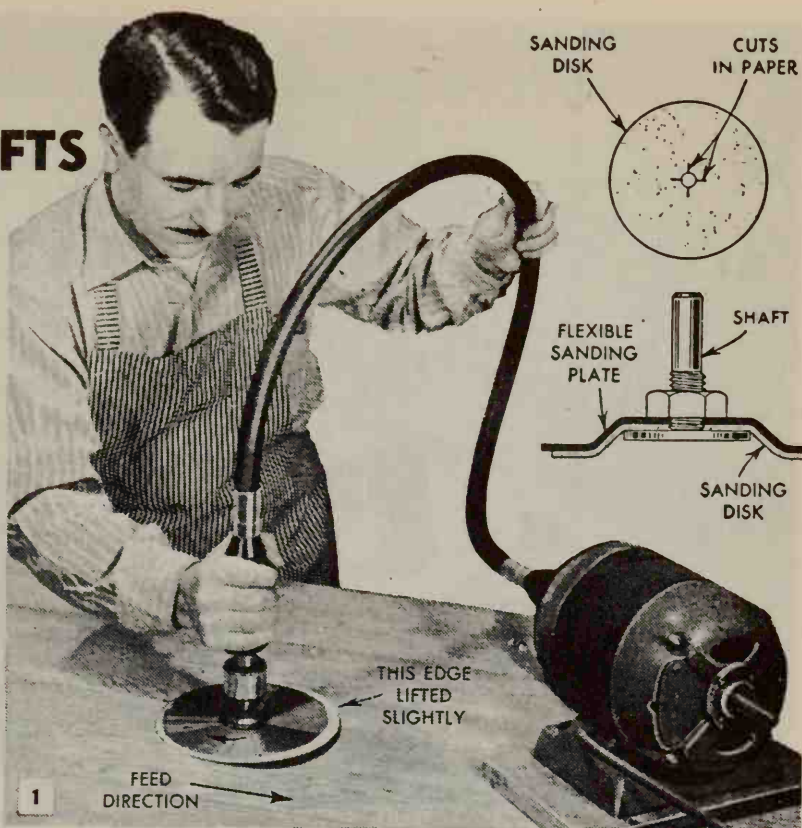
4th. Molds are filled level with concrete, tamped and troweled. Straightedge is used to rake off excess

5th. Removal of the sheet-metal molds is easy. Just cut the wire holding the ends and jerk the strip free



6th. The edges of the "stones" are scraped lightly and sod is placed between them $\frac{3}{4}$ in. below top

FLEXIBLE-SHAFTS



A FLEXIBLE SHAFT combines both the power and uses of many different tools in a handy portable unit. With it, you can carve, drill, sand, rout, buff, wire-brush, saw, polish and grind simply by using the necessary accessories on the projecting end of the shaft at the handpiece, Figs. 2 to 4 and 7 to 9 inclusive. Large flexible shafts are widely used in industry for such heavy operations as removing rust and scale, grinding welds, polishing large surfaces of metal and snagging castings.

Flexible shafts usually are rated large or small according to the size of the shaft, or core, as it is called. A large flexible shaft is one having a core $\frac{5}{16}$ in. in diameter or larger, while a small shaft is one having a $\frac{1}{8}$ to $\frac{1}{4}$ -in. core. The large shafts will transmit power for the heaviest work that can be done with hand-held tools, and small shafts are especially suited to use with tiny rotary files, grinding wheels and polishers, which must be rotated at extremely high speeds. The small shafts are quite flexible and will operate efficiently when curved to a comparatively short radius.



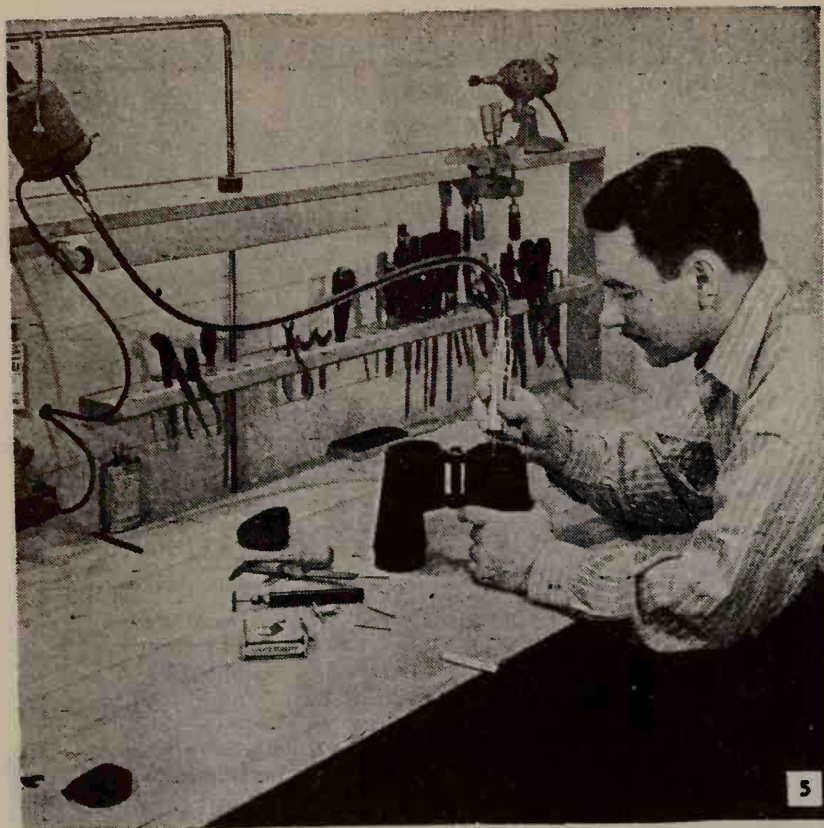
2
SANDING



3
GRINDING

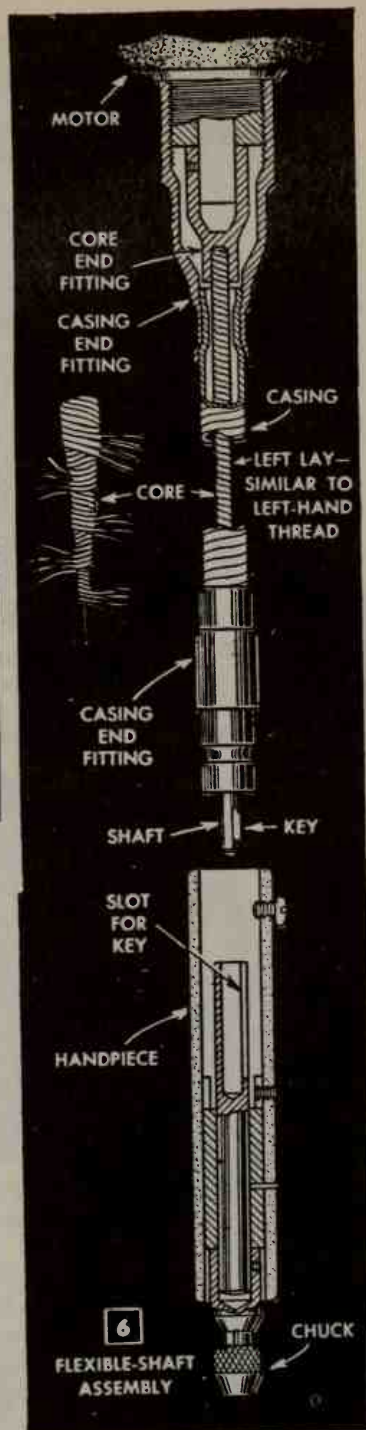


4
POLISHING



A flexible shaft consists of a stationary casing and a core, which rotates inside the casing. The core, in both the large and small sizes, is a precision-built unit consisting of layers of spring-steel piano wire wound to produce an alternating right and left-hand pitch, as in Fig. 6. The pitch of the outside layer determines the direction in which the shaft should be rotated. Most shafts are left pitch and should be operated in a clockwise direction, as this movement tends to tighten the outer winding of wire. Clockwise direction of rotation is common to lathes, drill presses and also to most types of motors. It is possible to reverse the direction of rotation of the shaft where the work load will at no time exceed half the power rating.

Although some casings consist only of a continuous spring-steel strip wound spirally with interlocking edges, most of the better-quality shafts are fitted with casings of braided wire and molded rubber or fabric coverings which give somewhat greater flexibility and ease of handling. Small shafts designed for high speeds often have a spiral inner liner which fits loosely over the core and has the effect



BUFFING



DRILLING



CARVING

FLEXIBLE SHAFT DATA

① CORE DIAMETER	② HP. AT 1750 R.P.M.	③ MAXIMUM SPEED	④ MINIMUM RADIUS	⑤ LARGEST GRINDING WHEEL	⑥ DEFLECTION PER FT. OF LENGTH	SPECIFIC USES
$\frac{1}{16}$ "	1/100	25,000 R.P.M.	4"	$\frac{1}{2}$ " DIA.	100°	VERY DELICATE WORK ONLY —LIMITED USES
$\frac{1}{8}$ "	1/18	18,000 R.P.M.	5"	1" DIA.	70°	ALL KINDS OF CRAFTWORK WHERE FLEXIBILITY AND CONTROL ARE MORE IMPOR- TANT THAN POWER
$\frac{3}{16}$ "	1/10	12,000 R.P.M.	6"	2" DIA.	40°	
$\frac{1}{4}$ "	1/6	8,000 R.P.M.	6"	3" DIA.	30°	LIGHT DUTY CONTINUOUS BUFFING, POLISHING AND GRINDING. SINGLE OR MULTIPLE-SPEED UNITS
$\frac{5}{16}$ "	1/4	7,000 R.P.M.	7"	3½" DIA.	22°	
$\frac{3}{8}$ "	1/3	6,000 R.P.M.	8"	4" DIA.	18°	USUALLY 4-SPEED UNITS. USED FOR ALL KINDS OF MEDIUM TO HEAVY SANDING, GRINDING, ETC., PREFERABLY AT A FIXED LOCATION
$\frac{7}{16}$ "	1/2	5,000 R.P.M.	10"	5" DIA.	15°	
$\frac{1}{2}$ "	3/4	4,200 R.P.M.	10"	6" DIA.	11°	

① General average values—cores of the same dia. may vary in construction so that values given are only an all-around average.

② This column lists largest motor generally used. Safety factor is about 4. Motor power can be increased proportionately with increase in shaft speed. Example, $\frac{1}{4}$ -in. core can handle 1/6 hp. at 1750 r.p.m., or 1/3 hp. at 3600 r.p.m.

③ Main consideration is the prevention of shaft overheating which occurs if shaft runs much over 500 surface feet per minute. Most shafts under $\frac{1}{4}$ -in. dia. are powered with universal motors and will run much slower than "no load" speed of motor.

④ Values given are normal for good power transmission but shafts can be worked at sharper curves for occasional work.

⑤ These diameters are based on what the shaft will stand and also on how fast any grinding wheel can be operated with safety. Wire brushes, buffs and sanding disks can be larger.

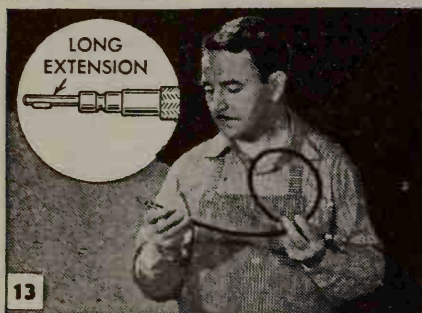
⑥ This column shows deflection or "windup" of shaft under full load. A $\frac{1}{8}$ -in. shaft, for example, will deflect 70 deg. per foot. If the shaft is 3 ft. long, total deflection will be 210 deg. or a little over $\frac{1}{2}$ of a full turn.



of reducing friction. Connecting members of the shaft are press-fitted into the casing and are designed to permit coupling directly to the motor at one end and to the handpiece at the other. When the shaft is operated straight or nearly so, Fig. 12, the end of the core extends only slightly. Fig. 13 shows how the core extends when the shaft is flexed. One end of the core is fixed in the connector and the other end is splined or keyed to the connector to permit movement in and out when the shaft is operated on a comparatively short radius. On some shafts, this movement is taken up at the motor end, the handpiece end being fixed. Shafts of this type can be attached directly to a motor shaft, Fig. 1, or to a drill press, Fig. 18. When connected to the drill press, as in Fig. 18, it should be kept in mind that the torque of the drill-press spindle far exceeds the load limit of the shaft.

Simplified data on the common sizes of flexible shafts is given in the table, Fig. 10. The data given is not exact but is average for all shafts. If you want a shaft for light craftwork, such as modelmaking, the $\frac{1}{8}$ to $\frac{3}{16}$ -in. core size is a good selection. For heavy grinding, buffing, and wire-brushing, the $\frac{3}{8}$ -in. core is sufficiently strong to take the torque of motors up to $\frac{1}{2}$ hp. For the small shaft, the handiest length is 3 to 3½ ft. and the large shaft should be 5 to 6 ft. long. Such shafts are available as motor-and-shaft units with variable speeds, and also for direct attachment to motors, or any spindle of proper size and speed.

The business end of the flexible shaft is the handpiece and, in the larger units, many different types of handpieces are



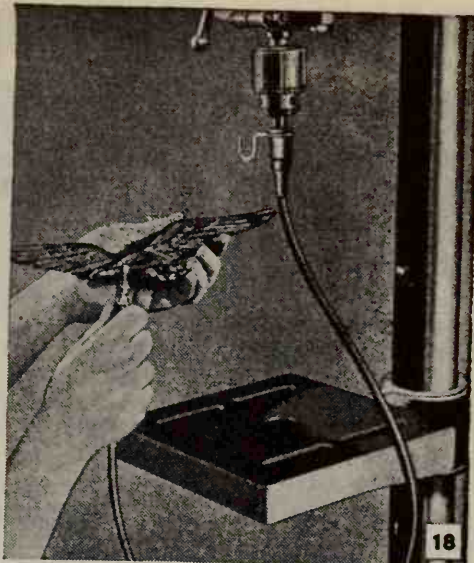
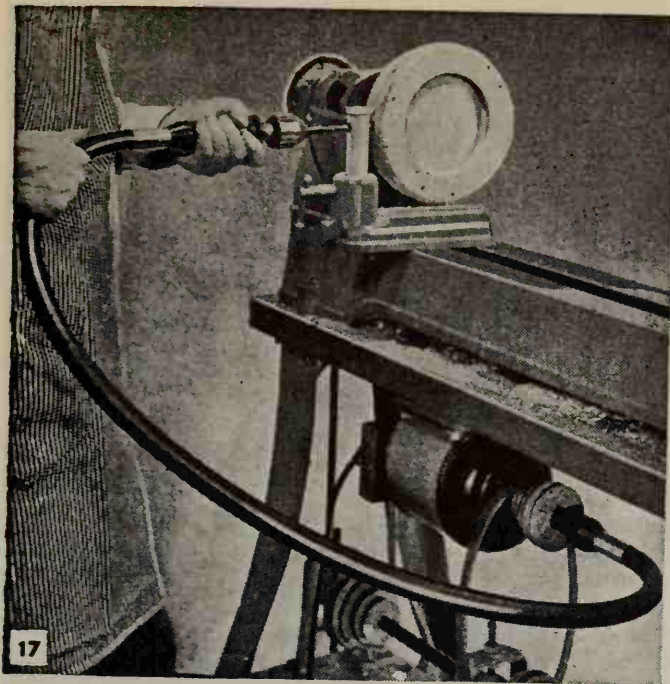
available. The straight, spindle-type handpiece, Fig. 11, usually is supplied with the large shaft. Flanges for this handpiece permit mounting accessories which have a center hole and can be held between the flanges. A hand-closing chuck having a threaded shank, which can be screwed onto the handpiece spindle, is useful for holding drills and any other tools having shanks of a diameter within the capacity of the chuck. Grinding wheels should not exceed the diameter given in the table, but such accessories as cloth buffs and sanding disks can exceed the grinding-wheel diameters by as much as 25 percent. A common handpiece supplied with the small shafts is either a collet chuck or a chuck tightened by means of a special key or spanner-type wrench, Fig. 11. These usually have a capacity of $\frac{3}{32}$ or $\frac{1}{8}$ in., adapters being available for holding the in-between sizes. Such chucks are ideally suited to driving mounted grinding wheels, wire brushes and small rotary files. The key-type chuck is available in either sleeve-bearing or ball-bearing construction, but collet chucks usually are supplied only with sleeve bearings. Right-angle handpieces are supplied for use with the heavy shafts. Figs. 2 and 4 show this type of handpiece in use.



MOTOR MOUNTS

Motors for powering small flexible shafts should be supported with a swivel joint for ease in manipulation. Fig. 14 shows a motor hanging from a vertical arm which is held by a toolbox. For portability, the motor can be carried on a shoulder strap as in Fig. 15. Benchwork requires that motor be supported overhead. See Fig. 16





Power take-off for driving flexible shaft can be made from drill-press spindle, as above, or from lathe motor, as at the left



Core of shaft is cleaned and lubricated at regular intervals

Proper installation of the flexible-shaft unit is necessary if you are to get the most out of this versatile tool. One of the handiest arrangements for using a small shaft-and-motor unit is that in Fig. 5. On such units, the motor is provided with a bail or hook so it can be hung at some point above the work. In this case, a swinging arm mounted on the bench tool panel makes it possible to use the shaft unit at any point on the bench top. Other applications, using the same motor unit, are shown in Figs. 14, 15 and 16. Similar units are available with larger shafts and motors. The larger units also are supplied with a special floor stand as in Figs. 2 and 3. On these units, the motor base swivels, permitting the unit to follow the movements of the operator without undue flexing of the shaft. In small commercial shops and home workshops, the larger shafts can be set up as in Fig. 1, the motor being bolted to a wooden base.

The same type of shaft as that in Fig. 1 is shown in a somewhat different adaptation in Fig. 17 where it is being driven by the lathe motor and is used to drill index holes in a wood turning. In the setup shown in Fig. 1, maximum freedom of movement is obtained with the end of the motor shaft toward the operator, a trick to remember when operating a flexible shaft with the motor mounted on a stationary base. Disk-sanding is done with a special flexible disk constructed as shown in the details in Fig. 1. The abrasive disk usually is not attached to the backing disk with adhesive but is held in place by a recessed flange. In operating a disk of this type on large flat surfaces, make a one-way stroke with the leading edge of the disk lifted slightly as shown. In this way, the trailing edge will not leave scratches on the work. A lamb's-wool bonnet for polishing can be fitted over this type of disk.

Flexible shafts used intermittently need little servicing, except that care should be taken to make sure that the shaft does not run without lubricant. Dismantle the shaft at regular intervals and clean all the parts with a solvent as in Fig. 19. When assembling after cleaning, renew the lubricant with the grade specified by the manufacturer. Ball-bearing handpieces usually are provided with separate oilholes having ball closures. These handpieces should be lubricated at regular intervals with a medium machine oil or any special lubricant specified by the manufacturer.

(Certain photos courtesy R. G. Haskins Co., Delta Mfg. Co., Freedom Electric Co., and The Dumore Co.)

FLEXIBLE-SHAFT UNIT MADE IN THE SHOP

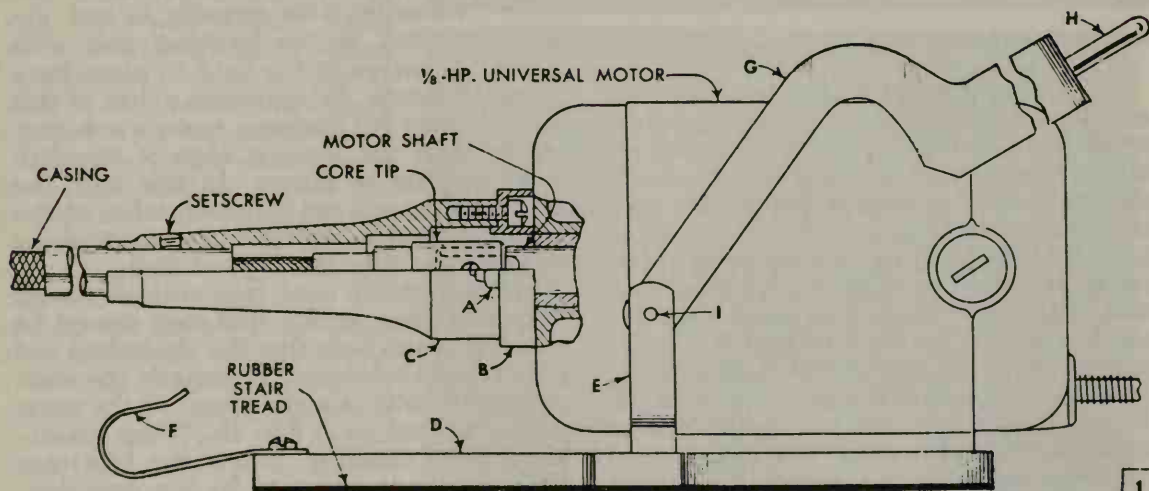
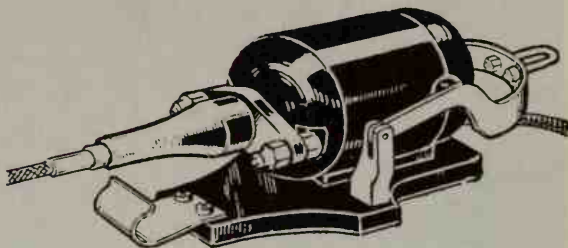
FOR FINE, freehand filing, carving, grinding and drilling on small parts, you can't beat a high-speed flexible shaft having a suspended, direct motor drive. By using a small stock motor, such as a $\frac{1}{8}$ -hp., together with a flexible shaft and making other necessary parts yourself, it is comparatively easy to assemble such a unit as that shown in Fig. 1. The motor and shaft are assembled as a unit, using a special ferrule and flange, and then the motor is attached to a base plate fitted with a bail which permits the shaft and motor to swing free when suspended from an overhead hook. In addition to the bail, the base features a nonslip surface to permit using the unit in a horizontal position.

The base, D, is made from a $\frac{5}{16}$ -in. steel plate sawed and filed to the contour shown in Fig. 2. Drill and counterbore holes for mounting the motor and the bail arms, E. The bail is shown in half pattern and is made from 16-ga. steel. After forming and drilling holes for the pivot pins, I, and the eye, H, the eye is bent to a U-shape on a center line midway between the two holes.

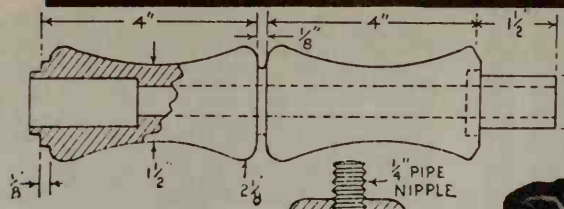
The tricky part of the whole assembly is fitting the shaft to the motor. Most small flexible shafts are supplied with a ferrule internally threaded to fit a motor already



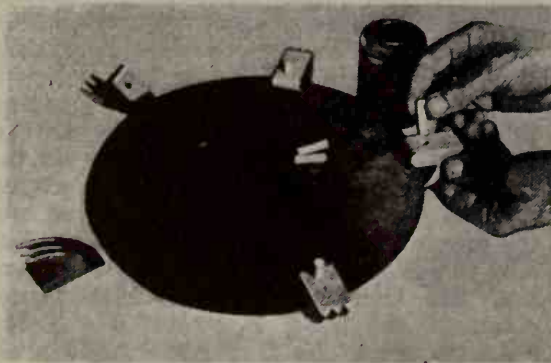
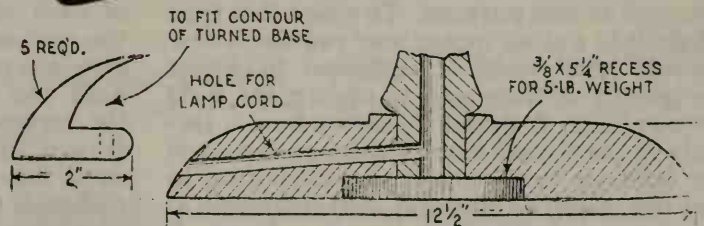
Hang it up or use horizontally



FLOOR LAMP



In making this attractive lamp, short sections are turned to the shape shown in the upper detail, and glued together to form a standard that appears to be a long, continuous turning. This method of assembly is easier than turning a long standard and boring it for the electrical cord. When fitting the sections together, the grain of the wood should be matched as nearly as possible so that the standard looks like one piece of wood. The top end is fitted with a $\frac{1}{4}$ -in. nipple to which the lamp head is attached, and the bottom end is turned to fit a hole in the base. If a new head is not available, you can use one taken from a discarded lamp



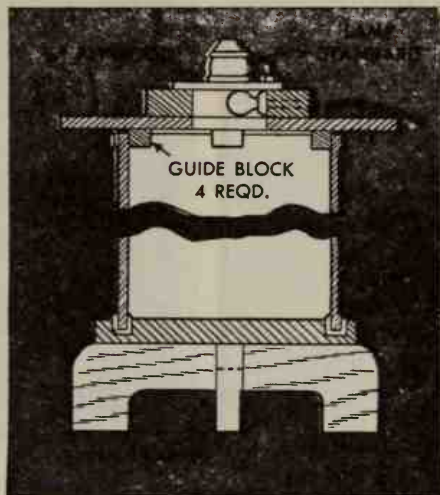
If material thick enough for the turned base is unavailable, it may be built up. A recess is turned in the underside to take a 5-lb. lead weight, which may be taken from an old floor lamp

The interesting maple feet are turned at one time, shellacked and polished while in the lathe, then marked off and scrollsawed as shown. These are glued to the base, using $\frac{5}{16}$ -in. dowels

Featuring an illuminated tropical aquarium, this unusual floor lamp combines beauty with utility. The lamp is relatively easy to build, the one pictured being made entirely with hand tools. An old floor lamp cut to the desired length provided the standard and lighting fixture for the aquarium lamp. However, if you have a wood lathe, the lamp standard can be a split turning which is first grooved for the wiring and then glued back together. Note that the 15-watt aquarium bulb is controlled by a small push-button switch making it independent of the floor lamp.

On the original lamp, the aquarium was fashioned from the glass bowl of a discarded gasoline pump. As one end of the bowl was broken upon removal from the pump, the irregular edge was cut off by clamping a 2-in. rubber belt around the bowl, marking the glass with a glass cutter and then tapping lightly on the inside. If this type of bowl cannot be found, a 5-gal. water bottle with the top cut off will serve the purpose. The aquarium rests on a wooden base consisting of a disk screwed to half-lapped legs. The bowl is set in a circular groove cut in the top surface of the disk. After the base has been stained and given three coats of marine-grade spar varnish, a strip of putty is placed in the bottom of the groove. Then the bowl is pressed into the putty and the joint is made watertight by tamping putty into the groove on both sides of the glass. As the pump-bowl glass was $\frac{1}{4}$ in. thick, a $\frac{1}{2} \times \frac{1}{2}$ -in. groove was cut in the base, thus allowing room for the putty seal. A disk of $\frac{3}{4}$ -in. plywood forms

Unique Floor Lamp Has Aquarium Base Improvised From Gasoline-Pump Bowl



the aquarium top, and this is centered on the bowl by means of four guide blocks which fit against the inner surface of the glass. One-inch-square rubber spacers are glued to the plywood top at the outer edge of each guide block. These provide a bearing surface for the top of the bowl and also elevate the plywood disk to permit ventilation. If desired, the metal rim usually found around one end of the pump bowl can be left in place so that the plywood top will rest on the metal instead of the glass. The wooden lamp base, which houses the aquarium light, is attached to the plywood top by means of two dowel pins which fit in holes drilled in the plywood. The dowels align the lamp housing with a hole cut through the center of the aquarium top, and allow the entire lamp to be lifted from the aquarium when it is necessary to feed the fish. Small vent holes are drilled through the top of the aquarium-lamp housing and around the standard to keep the bulb from overheating.



FLOOR

Laying Finishing Repair



LAYING A HARDWOOD FLOOR

IF YOU are one of many homeowners who have purchased an old-type house and are remodeling it yourself, few improvements will increase its value and improve its interior appearance more than beautiful hardwood floors. Whether the condition of present floors is beyond refinishing and requires resurfacing with thin flooring, or whether an old softwood floor is to be covered, almost anyone who is handy with a hammer and saw can do the job with excellent results. Most of the tools required are common ones. Besides a hammer, you'll need handsaws for ripping and crosscutting, a nailset, a pair of dividers or a compass and a can of plastic wood putty to cover exposed nailheads where the flooring must be surface-nailed.

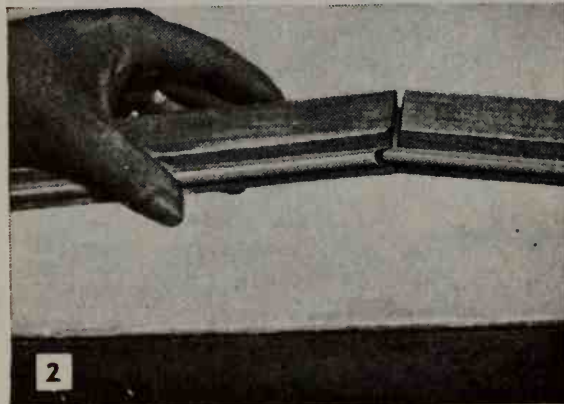
Complete instructions on how to finish

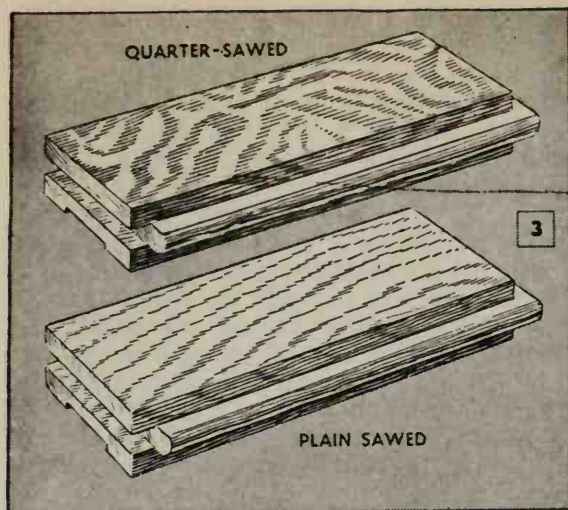
This is how the last strip of each row is marked for length with a try square by placing it end for end against the wall and parallel with adjoining strip

the new hardwood floor and refinish an old floor will be given later in this chapter, along with fully detailed suggestions on what to do about floors that creak, sag or vibrate and stairs that squeak. In laying the new hardwood floor, it is necessary to select a type of flooring that will suit your particular needs and add beauty to your home.

Types of flooring: The attractive grain of quarter-sawed flooring makes a beautiful job when waxed or varnished and, when available, is to be preferred to the plain or "flash sawed" type shown in Fig. 3. Quarter-sawed flooring is recognized by the wavy pattern of surface grain and by the slant of the growth rings in the end grain. It is somewhat more expensive than plain-sawed flooring, but has less tendency to curl and surface splinter. Flooring is usually sold in bundles of strips ranging in length from 2 to 12 ft. or more and end-

Flooring is sold in bundles of strips of random lengths up to 12 ft., which are end and edge-matched with a tongue and groove, and cup-molded on the underside

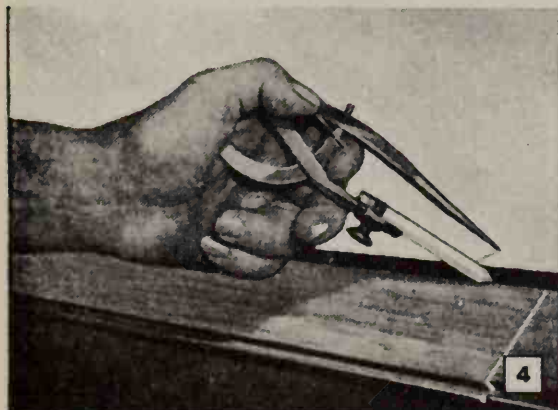




matched, Fig. 2, as well as edge-matched by a tongue and groove in the edge. The underside face of the strips is hollowed or cupped so that any unevenness of the subfloor will not interfere with their laying flat. Flooring can be had in four hardwoods: oak (white and red), maple, beech and birch. Oak flooring is available in strips of two standard widths and thicknesses. One measures $\frac{3}{8}$ by $1\frac{1}{2}$ in., the other $\frac{13}{16}$ by $2\frac{1}{4}$ in. The condition of the subfloor or nailing base determines largely the size and type of flooring to use. Some homeowners prefer a floor laid of narrow strips which are used in resurfacing an old hardwood floor and when the nailing base is solid. The $\frac{13}{16}$ -in. flooring generally is used over a rough subfloor or one that is not thick enough or properly reinforced to give adequate support to thin-type flooring.

Ready-finished flooring recently has been introduced which saves the work of finishing and the inconvenience encountered in waiting for the floor to dry. This feature is especially desirable when laying a new floor in an occupied house. It differs from regular flooring in that it has

Starting strip should be laid at right angles to side walls. If corners of room are not square, mark grooved edge of strip with compass to match wall



Finished with two coats of durable varnish, a hardwood floor will withstand rough usage by youngsters

a V-joint instead of a tongue and groove and, of course, it is stained, sealed or otherwise finished, ready for use as soon as it is laid. However, being prefinished, it requires great care in laying to avoid marring. To help reduce possible damage from hammer marks, the flooring is factory drilled for nails and is packaged for further protection. It naturally is considerably more expensive, as in addition to being finished, it is specially selected for straightness and uniform grain.

Keep flooring dry: Due to its low moisture content when kiln dried, flooring is highly subject to dampness and, until it is laid and completely finished, it is very important that it be kept *dry* at all times. This is especially so if the flooring is stored for any length of time prior to laying. It also is important that if laid during damp weather, the building be heated. If allowed to absorb moisture, a tightly laid floor will shrink when it dries out, leaving objectionable openings between the strips. In new construction, flooring should not be laid until the plaster has dried completely as it will absorb moisture from the walls.

Preliminary steps: The first step in laying a new floor is to inspect the old floor, or subfloor if it is new construction, for loose boards, ridges and any other high places that might prevent the new flooring from lying flat. Nail such places thoroughly to pull the boards down flush. This is important to assure a squeakless floor and prevent movement in the finished floor. In resurfacing a previously laid hard or softwood floor, it is advisable to remove the baseboard. This can be done without damaging the baseboard by locating the nails and driving them completely through and into the studs with a pin punch. Following this, the floor should be swept clean

and covered with a good grade of building paper, lapped at the sides and ends. Old softwood floors that are worn badly sometimes are covered first with plywood and special long nails used to apply the flooring. On new floors, the paper liner serves as a dust-and-draft barrier between the subfloor and finish floor, while on an old floor, which without doubt was originally laid over a paper covering, the new paper simply provides a smooth, clean, working surface.

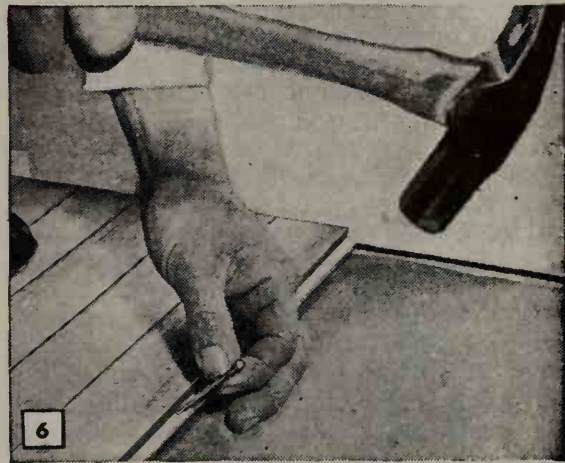
How flooring is nailed: Flooring is nailed blind, in other words toenailed, so that the nailheads are hidden. This is done by driving the nails into the angle between the tongue and front edge of the strip as shown in Fig. 6. Use 8-penny wire flooring nails or special cut-steel flooring nails and drive them at an angle of 45 deg. Experience will enable you to drive the nails practically all the way with a hammer, as in Fig. 9. However, it is advisable at first to drive them part way and finish with a nailset to avoid the possibility of accidentally damaging the edge of the flooring. If cut nails

are used, they can be driven home by using the side of the head of another nail as shown in Fig. 7. The important thing is to drive the head flush or slightly below the surface so that it will not interfere with drawing up the subsequent strip. In the case of very hard woods, such as maple or birch, it may be necessary to first drill holes for the nails to avoid splitting, especially if wire nails are used. The blunt nose of cut nails will not split the wood as readily, as they punch through the wood. The nails should be spaced about 8 in. in laying $\frac{3}{8}$ -in. flooring and from 10 to 16 in. for thick flooring. It pays to nail a floor well to avoid later squeaks and loose boards.

Laying the starting strip: If you are covering a badly worn hardwood floor, the new flooring is laid at right angles to the old. The first strip is selected for straightness and is laid with the grooved edge facing the wall and close enough so that the baseboard, if used, will cover any small opening. If the corners of the room are not square, the starting strip should be placed at a 90-deg. angle to the side wall, marked

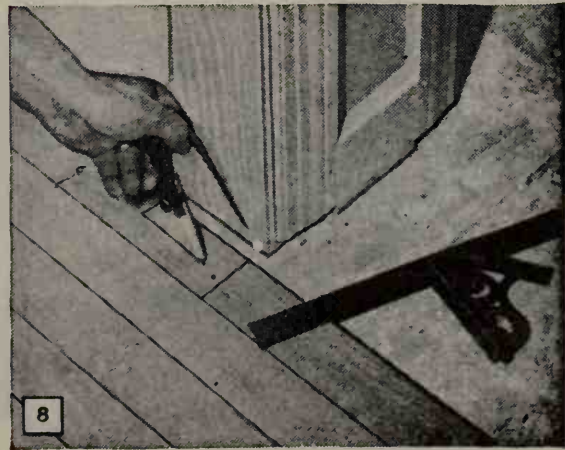
When waste portion of the last strip in each row is a foot or more in length it is used to start next row

Blind-nail each strip by nailing in angle of tongue and edge. Use 8-penny nails driven at 45-deg. angle



Each nailhead must be set flush or slightly below surface. Side of cut nail or regular nailset will do

Pencil compass is handy for marking strips when fitting flooring neatly around or under a door casing

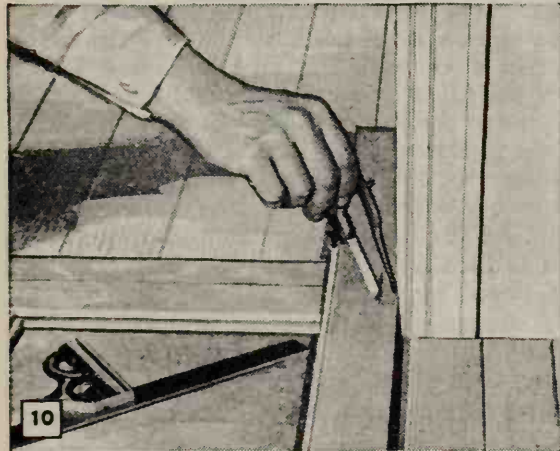


with a compass as in Fig. 4 and ripped to conform to the adjacent wall. This starting strip generally is face-nailed along the rear edge and sometimes it also is toenailed in the tongue. While it is best to have the starting strip in one piece, the size of the room may require several pieces laid end to end. In the latter case, if the piece cut off is greater than a foot in length, it usually is used to start the next row, Fig. 5. The last strip in each row is marked for length with a try square as in Fig. 1, after placing it end for end and against the wall. From here on it is a case of drawing the flooring strips of each row tightly against those of the preceding row to assure tight-fitting joints. For this purpose cut a scrap of flooring and use it to drive against. This will prevent damaging the tongue and will be found helpful in drawing up stubborn joints. Strips of flooring that are slightly bowed can be forced tightly against the preceding row by prying with a wooden block placed against a 2 by 4-in. lever and block temporarily nailed to the floor. The joints in each subsequent row always

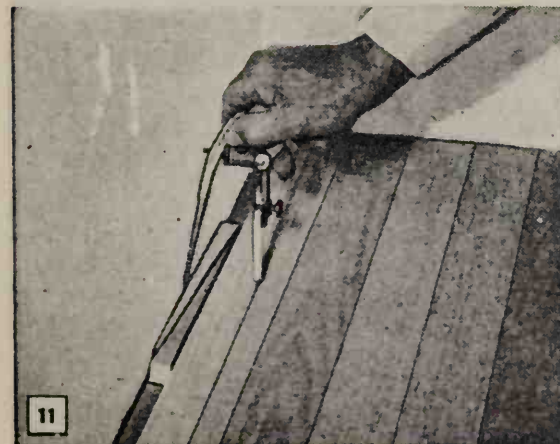
Abutting strips are placed crosswise to the door opening when ending the floor at bathroom or kitchen



Practice will enable you to drive nails rapidly from standing position. Heads are set later with nailset



Final fill-in strip is marked to conform to wall by wedging full-width strip and marking with compass



should be staggered at least 6 in. or more.

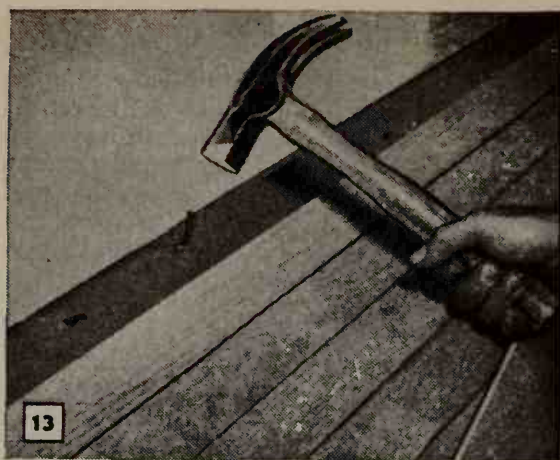
Notching around doorcasing: When you must fit the flooring around or under the casing of a doorway leading to an adjacent room or closet, a pair of dividers or a compass is used to mark the depth of the required notch. Fig. 8 illustrates how this is done, the flooring in this case being fitted to butt against the casing. If you are resurfacing an old floor and wish the flooring to run under the casing and jamb, it will be necessary to saw off these two pieces to allow for the extra thickness. As shown in Fig. 8, the strip to be marked is not nailed but is simply tapped temporarily in position and butted against the end of the adjoining strip in the same row. Note that the joint of the adjoining strip ends flush with the face of the jamb. Now, measure the space between the loose strip and the face of the casing and set the compass so that this distance is marked on the strip when one leg of the compass is held in contact with the casing. Any slight cant or irregularity of the casing will be transferred to the strip assuring a perfect-fitting butt joint. The loose strip is removed and replaced with a full-width strip, the two strips being laid at the same time to enable wedging snugly in place. When the direction of the flooring runs through a doorway and you wish the new floor to end in



Bowed fill-in strip is forced in place tightly for marking by prying against wall with board and block

the center of the opening as in Fig. 10, the compass method is used as before to mark the strip to fit the jamb. Note here that one or two strips of flooring are first nailed down parallel with the opening and serve as header strips against which the flooring is butted. This generally applies when a hardwood floor is butted against a bathroom or kitchen floor which is to be built up flush and covered with linoleum.

Fitting final strips: If no baseboards are to be used and only a shoe mold, the steps in fitting the last remaining strips are shown in Figs. 11 to 15 inclusive. When the space remaining along the wall is less than a full width of flooring, the strip next to



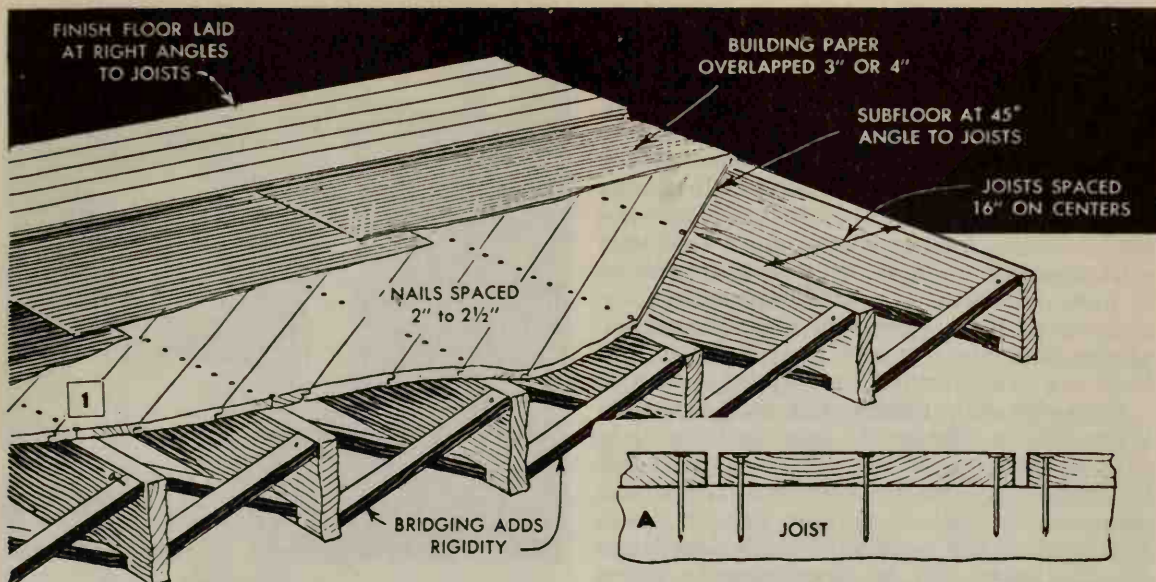
Drive nails part way and bend them over to support narrow fill-in strip flush with the rest of the flooring

the final one is set in place temporarily and wedged either with tapered blocks as shown in Fig. 11, or forced in place by prying as shown in Fig. 12. After this it is marked, as before, with a compass to transfer the contour of the wall, then ripped and used as a fill-in strip. Due to the fact that flooring is cupped or hollowed on the underside and ripping removes one supporting edge, a few nails should be driven part way into the subfloor and bent over, as shown in Fig. 13, to support the fill-in strip flush with the others. Actual laying of the fill-in strip and the last few strips is done at the same time, as in Fig. 14, so that the matched edges will go in place. Tapping with a hammer and wooden block will drive them into position as shown in Fig. 15. As the fill-in strip cannot be toenailed, it is face-nailed so that the heads will be covered by the shoe mold. Fitting the fill-in strip tightly is not so important when both baseboard and shoe mold are used, as together they will cover any slight gap that may remain along the wall.

To permit inserting the fill-in strip, last few strips are laid at same time to engage the matched edges

Fill-in strips and others are gradually forced down with hammer and block. Then the strip is face-nailed





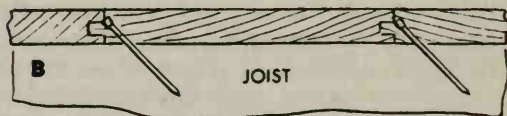
FLOOR CARE AND REPAIR

As floors are subjected to more wear and all-around harder usage than any other structural part of the home, they should be given proportionally more care. The common wood used in laying floors in private houses has been so satisfactory and inexpensive that no substitute is available or desired. Many different woods are available as prepared floor boards, either square-edges or tongue-and-groove. The common woods are whitewood, maple, oak, birch and walnut. The boards should not be more than 5 in. wide, to avoid open joints through shrinkage. Stock sizes are from $\frac{1}{2}$ to $1\frac{1}{4}$ in. thick and from $2\frac{1}{4}$ to 4 in. wide. It is common to have a rough floor of whitewood and to cover it with thinner hardwood boards, forming geometric designs. Wood floors are distinguished as single or double. Single floors consist of one layer of flooring only. Double floors have two layers of flooring, the subflooring being of rough lumber and topped with a finished floor.

Fig. 1 shows the common construction of a wooden floor. In the best type of work, the subfloor is laid diagonally and the finish floor at right angles to the joists, with a layer of building paper between the subfloor and the top floor. In new construction, plywood also is extensively used for subflooring. It is important that the subfloor be nailed securely to the joists and that the wood be thoroughly dry. Square-edged subfloors, spaced $\frac{1}{8}$ to $\frac{1}{4}$ in., are used frequently in humid climates and where buildings are unheated. In laying this type of subfloor, 8 or 10d nails are driven straight as in Fig. 2 A. Tongue-and-groove subflooring, as well as finish flooring, is nailed with 8d flooring nails driven



SQUARE-EDGE SUBFLOOR IS FACE-NAILED; SPACED $\frac{1}{8}$ " TO $\frac{1}{4}$ " FOR EXPANSION IN MOIST CLIMATES



2 TONGUE-AND-GROOVE FLOORING BLIND-NAILED WITH 8d FLOORING NAILS DRIVEN AT 45° ANGLE

through the tongue at a 45-deg. angle, and spaced from 8 to 12 in. apart as in Fig. 2 B. Rabbeted subflooring, or shiplap, is nailed straight with 10d flat-headed nails spaced 2 to $2\frac{1}{2}$ in. apart.

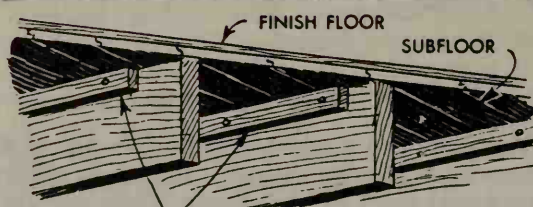
Squeaking floors: Shrinkage of wood often causes flooring to loosen slightly so that the boards rub on the nails and against each other, causing the floor to squeak when walked on. If the trouble is in the first floor, thin wedges driven between the top of the joists and the subfloor, as in Fig. 3, usually will stop the squeaks in that particular area. Where the tendency to squeak extends over a wide surface, strips of hardwood forced tightly against the underside of the subfloor and fastened with nails or screws will help, Fig. 4. A squeaky second floor over a ceiling is a different problem. The simplest remedy is to drive flooring nails through both the finish floor and the subfloor into the joists. Fig. 5, details A, B and C, shows how to locate concealed joists. Slide a hardwood block along the floor at right angles to the joists, tapping it continuously with a hammer. When the block is directly over a joist the tapping gives off a solid sound, but anywhere between joists a hollow sound results. Determine the exact position of a joist by drilling a small hole close to the joist as in detail B. Bend a wire feeler as in detail C and insert this through the hole, turning it until the bent end contacts the joist under the floor. Mark

the angle of the handle on the floor to locate the side of the joist. It is then easy to cross-nail the floor to the joist as in detail D. Avoid hammer marks on the floor by driving the nails only part way in, and sinking the heads below the surface with a nailset. After locating one joist in the manner described, measure 16 in. from its center to locate the next one. As a common joist spacing is 16 in. center-to-center, it is easy to drive the nails accurately by measuring 16 in. each way from the center of the joist first located. Nail holes in the floor are closed with filler stained to match.

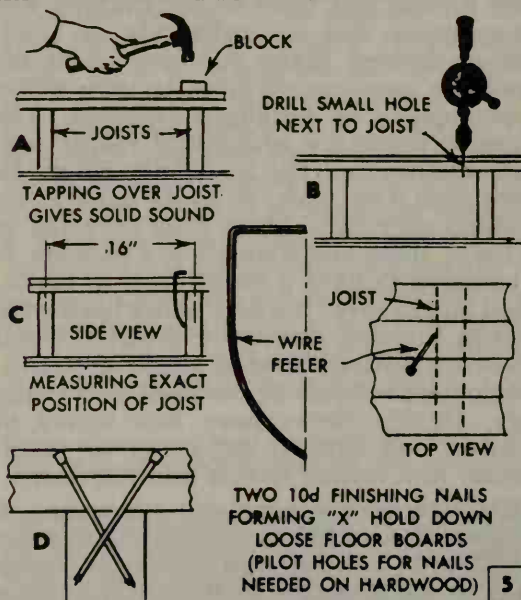
Squeaky stair treads: On open stairs, it is possible to silence the squeaks by simply driving the wedges tight. These wedges will be found inserted between the treads and stringers on the underside of the stair. However, if the stair well is plastered under the stair will be necessary to drive nails or screws through the offending treads into the risers or stringers as in Fig. 6. Counterbore the screw holes and after driving the screws, plug the holes with readymade screw-hole plugs of a matching wood—or better, with boat plugs which are cut at right angles to the grain. Sand the plugs flush, stain and refinish.

Raising sagged floors: Undue settling of floors at the center of the house often is due to rotting of wooden girder posts. In some cases uneven floors are caused by sagging of the girder between posts. To replace a post, first set up temporary supports on each side of the girder joint as in Fig. 7, with the lower ends of the supports resting on jackscrews. Make sure that the supporting posts are perpendicular, and raise the jackscrews until the weight is fully supported. Spike a 4 x 6-in. bridge block to the underside of the girder across the girder joint as in Fig. 8 and place a steel jack post as indicated, with its lower end bearing squarely on the concrete footing and its upper end centered against the underside of the bridge block. Now, being sure that the supporting jack post is perpendicular, tighten the jack at the top end to take the weight. The steel post is left in place permanently. Where additional supporting posts are required to straighten a sagging girder, it will be necessary to break up a portion of the concrete floor and pour a substantial footing for each post as in Fig. 9. After placing the jack post under a sagging girder, turn the jack up so that it takes the weight, and then raise the girder $\frac{1}{8}$ in. at intervals over a period of time. In this way, loosening of framing nails and excessive cracking of plaster will be avoided.

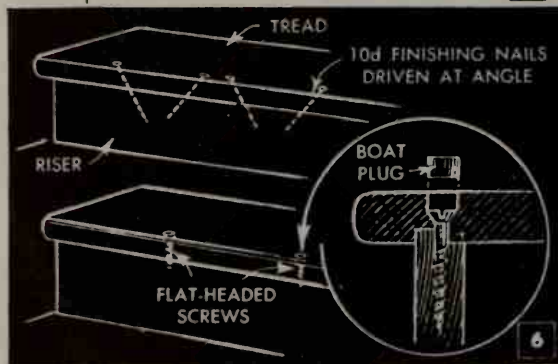
Vibrating floors: Floors that vibrate when walked upon result from inadequate support, such as the use of joists which are too small in cross-sectional area, too long a



1" WOOD STRIPS FORCED UP AGAINST LOOSE FLOOR BOARDS AND NAILED TO JOISTS



TAPPING OVER JOIST GIVES SOLID SOUND
DRILL SMALL HOLE NEXT TO JOIST
SIDE VIEW
MEASURING EXACT POSITION OF JOIST
TOP VIEW
TWO 10d FINISHING NAILS FORMING "X" HOLD DOWN LOOSE FLOOR BOARDS (PILOT HOLES FOR NAILS NEEDED ON HARDWOOD)





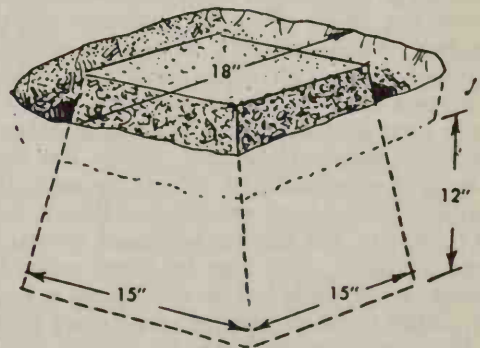
Above, to correct sagging of first floor, one or more temporary supports are placed under girder with the lower ends bearing on jackscrews. Below, the old post is then removed and replaced with a new-type steel post having a built-in jack for raising the girder



span between supporting girders, and insufficient or improperly located bridging between the joists, Fig. 1. There are several simple remedies that can be applied where the floor is open on the underside. Doubling the joists by nailing or bolting an additional member to each of those already installed often is practical and effective. Jacking up the floor from underneath and installing additional lines of bridging is nearly always a sure remedy. When vibration occurs in the second floor, the ceiling of the first floor may have to be opened to install bridging or extra joists.

Gap at shoe mold: Settling and shrinkage of wood often cause unsightly gaps between the baseboard and the shoe mold. Details A and B of Fig. 11 show what happens when the shoe mold is nailed either to the baseboard or to the finish floor. To make it easy to close these openings when they occur, the nails holding the shoe mold should be driven diagonally between the baseboard and the finish floor and into the subfloor as in detail C. This latter method of nailing can be used only if there is space equal to the width of the baseboard between the floor and wall. Otherwise, the only way to eliminate the gap is to renail or replace the shoe mold periodically, Fig. 10.

Refinishing wooden floors: When hardwood floors are in good condition and the finish is not excessively marred or worn down to the bare wood in spots, refinishing without resurfacing, Fig. 12, is entirely practical. The floor should be thoroughly cleaned before refinishing, and all wax must be removed with turpentine. On ordinary work there is a choice of two types of floor finishes: (1) Floor sealers which penetrate into the wood, and (2) Floor varnish, shellac and paint, the latter three forming a coating on the surface. Floors treated with a sealer do not show scratches or streaks as readily as do varnished or shellacked floors. However, the sealers used alone are not as durable. The finish must be cleaned and renewed more frequently. Cleaning can be done with a me-

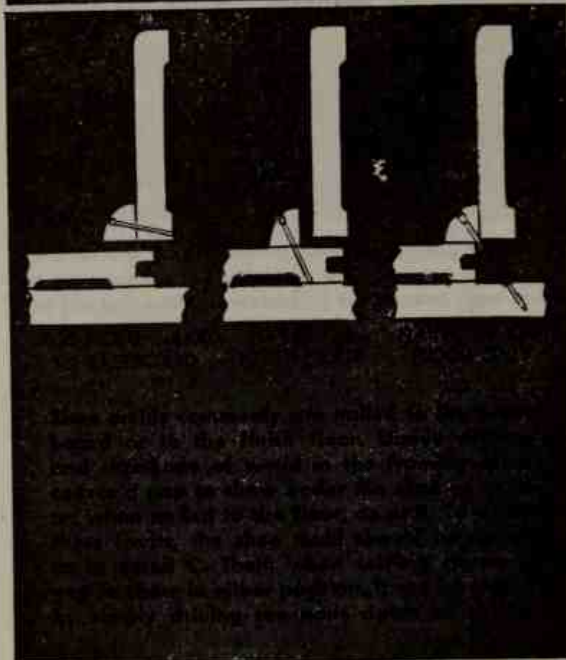


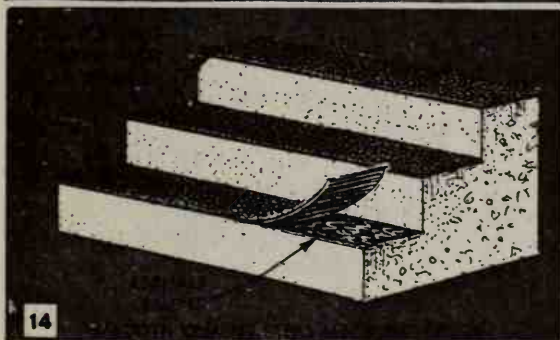
CONCRETE FOOTING FOR EXTRA GIRDER POST

dium solution of trisodium phosphate. After washing the floor, there may be some discoloration and, if so, the wood can be bleached to a uniform color with a mild solution of oxalic-acid crystals (poison) and water. This is applied to the floor with a cloth swab and then rinsed off with clear water. Usually a single application is sufficient. Water in the solution will raise the grain of the wood, so, the floor should be sanded lightly before a finish is applied. (Caution: When sanding a floor on which a bleach has been used, wear a dust respirator.) Floor sealer must be laid on quickly, either with a wool applicator or with a wide-bristle brush, first working across and then with the grain. Allow the sealer to set for a few minutes and then wipe off the excess. When the sealer is dry, smooth the floor with No. 2 steel wool. When finishing a floor, start at the corner farthest from the door and cover the floor in strips 4 to 6 boards wide, ending up at the door opening. Clean up the dust as you go with a painters' tack rag and leave the window sash open at the top and bottom and the door slightly ajar until the finish is dry. White shellac is quite extensively used as a wax base on hardwood floors because it dries so quickly that the floor can be back in service within a day's time.

Resurfacing wooden floors: When a floor is uneven and its surface has become badly worn, resurfacing with a sanding machine, Fig. 13, will be necessary. These machines can be rented from most hardware and paint stores. Removal of varnish or paint will require the use of a No. 4 open-coat abrasive. After the finish is removed down to bare wood, use a No. 2 abrasive for reducing the deep scratches made by the coarse abrasive. Do not stop the machine while the sanding drum is in contact with the floor, but rather allow the machine to pull itself across the floor. After high spots and the old finish have been removed with the two coarser grades of abrasives, finish a hardwood floor with No. $\frac{1}{2}$ or No. 0 abrasive. Most floor sanders will not run closer than 2 or 3 in. from the baseboard. This strip is finished with an electric edger, using the same abrasive grits as with the sander. Avoid getting the floor soiled or marked during or after sanding. If the resurfaced floor is to be stained, apply the stain first and then the filler, and after the latter is thoroughly dry, apply the finish. Use two applications of sealer and three coats of varnish on resurfaced floors. Allow 36 to 48 hrs. for drying between coats. Any type of floor wax can be used over floor sealer or varnish but do not apply a water-emulsion (self-polishing) wax over shellac.

Painting concrete floors: There are two general types of concrete floor paints, the





varnish-base enamel type and the rubber-base type. Use the former on concrete floors that are above grade and uniformly dry. The rubber-base concrete paints are suitable only for use on concrete floors below grade which are protected from direct sunlight. Rubber-base paints can be applied only to unpainted concrete floors, and should not be applied over any other type of paint. There also are combination concrete sealers and stains. These do not have the color brilliance of the others but do have an advantage in that worn spots can be finished to match other areas of the floor without producing a spotty appearance. In any case, new concrete should age for a year before being painted. Before painting, apply a neutralizer consisting of zinc-sulphate crystals, 3 lbs., dissolved in water, 1 gal. Concrete floors that have been troweled smooth should be etched to assure good adhesion of paint. An etching solution is made by slowly adding muriatic acid, 1 pint, to water, 1 gal., while stirring constantly. (*Caution:* Do not allow the acid or solution to touch the clothing or skin as it can cause severe burns. Avoid inhaling the fumes.) Apply the solution with a cloth swab, and allow to stand for 10 to 20 minutes. Then wash off with a soda solution to remove the acid and also to neutralize any remaining on the surface. Finally, flush off the floor with a quantity of clear water. To minimize dusting of unpainted concrete floors apply a hardener made by dissolving magnesium fluosilicate crystals, 2 lbs., in water, 1 gal. Allow the first application to dry 24 hrs. and then follow with a second application. This treatment may be followed by painting. Smoothly troweled concrete steps which are slippery when wet can be made slip-proof by etching as described, or by covering the treads with pieces of roll roofing laid on asphalt cement as in Fig. 14. The surface of the roofing is given three coats of spar varnish or enamel to bind the slate surfacing. Oil or grease spots on driveways and concrete floors can be removed by scrubbing with a solution of trisodium phosphate, 4 oz., and water, 1 gal. After scrubbing, sprinkle hydrated lime over the stained area and allow it to remain for several hours before sweeping it up. This will remove the oil, and generally most, if not all, of the stain.

Floor coverings: A common trouble with new floor coverings is lack of complete adhesion. When single tiles or blocks loosen, it will be necessary to remove the block entirely and replace it over new adhesive. To cement asphalt tile, use asphalt emulsion and spread it very thinly, as excess cement oozing up between the tiles may cause discoloration. The cement is allowed to set until tacky (unless instructions.

direct otherwise) and then the tile is laid carefully in place. Asphalt tile can be cemented directly to smooth concrete floors above grade. On wooden floors, asphalt tile must be laid on an asphalt-impregnated felt cemented to the floor with lignin paste. Edges of the felt are butted, not lapped. Wooden flooring blocks can be easily cemented directly to concrete or wood with a hot asphalt cement specially made for the purpose. Lignin paste is used to cement cork and linoleum floor coverings. If the floor covering must be cleaned frequently by mopping or flushing with water, it is best to use resin cement and asphalt-impregnated felt as a base. For bonding rubber tile, lignin paste, rubber cement or latex cement may be used.

Cleaning and waxing floors: Varnished or shellacked floors which are not waxed should be cleaned with an oiled mop. Floors coated with a sealer can be washed with a slightly soapy water, rinsed with a wet cloth and then wiped dry. Clean waxed floors with a soft floor brush. Do not use an oiled mop as oil softens the wax. To remove embedded grime, rub lightly with a soft cloth wrung out in warm, soapy water. Clean painted concrete floors with plain water. Linoleum floors that are not waxed or lacquered are washed with a mild solution of trisodium phosphate, care being taken that water does not seep under the edges to loosen the adhesive bond. Rubber-tile floors should not be cleaned with hot water. Use a solution of household ammonia in cold water. Most common stains on rubber floor coverings can be removed by rubbing the stained area with No. 00 steel wool. Cork flooring is ordinarily cleaned with a floor brush or a dry mop. If it is very dirty and soiled, use warm, soapy water applied with a cloth or sponge. Rinse and dry the floor immediately. Cleaners and polishes containing oils should not be used on asphalt tile. The



common floor waxes are of two kinds: (1) The paste and liquid waxes having volatile organic solvents, and (2) the water-emulsion waxes which are known as nonrubbing or self-polishing. The former require polishing either by hand or with an electric polisher, Fig. 15. Apply wax in thin coatings, each coat being wiped on at right angles to the previous one.

Hints on filler application: Sufficient filler for a room 12 x 14 ft. can be prepared inexpensively. Mix the filler in a large pan that can be discarded afterwards, and mix only enough for one room at a time, as shown below. The filler will stain the floor slightly. You can vary the amount of sienna to get darker or lighter effects. If still darker tones are desired, substitute burnt sienna or burnt umber for the raw sienna. Use pure benzine, not the kerosene-and-gasoline mixture sometimes sold. Apply the filler with a brush or a wad of cotton waste, first with and then across the grain as illustrated, lower left. Burlap sacking can be folded into useful four-ply pads, as illustrated in the picture above.



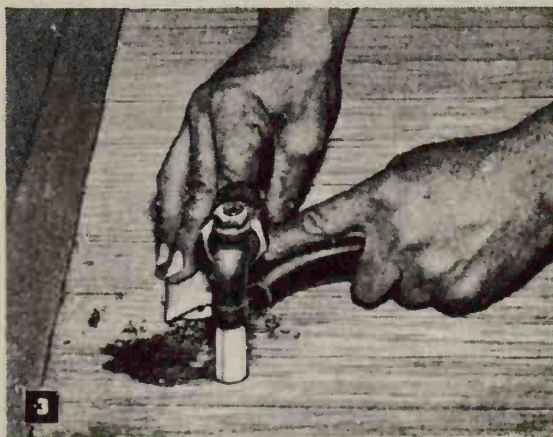
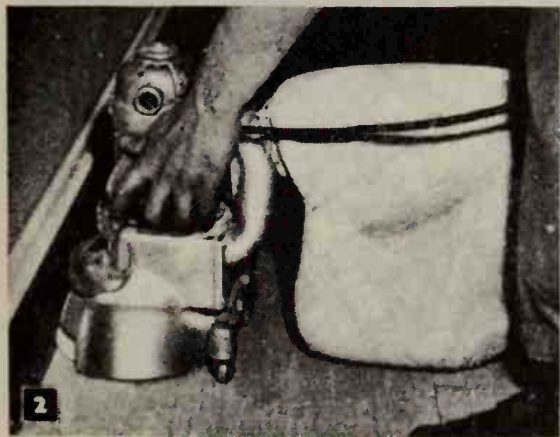
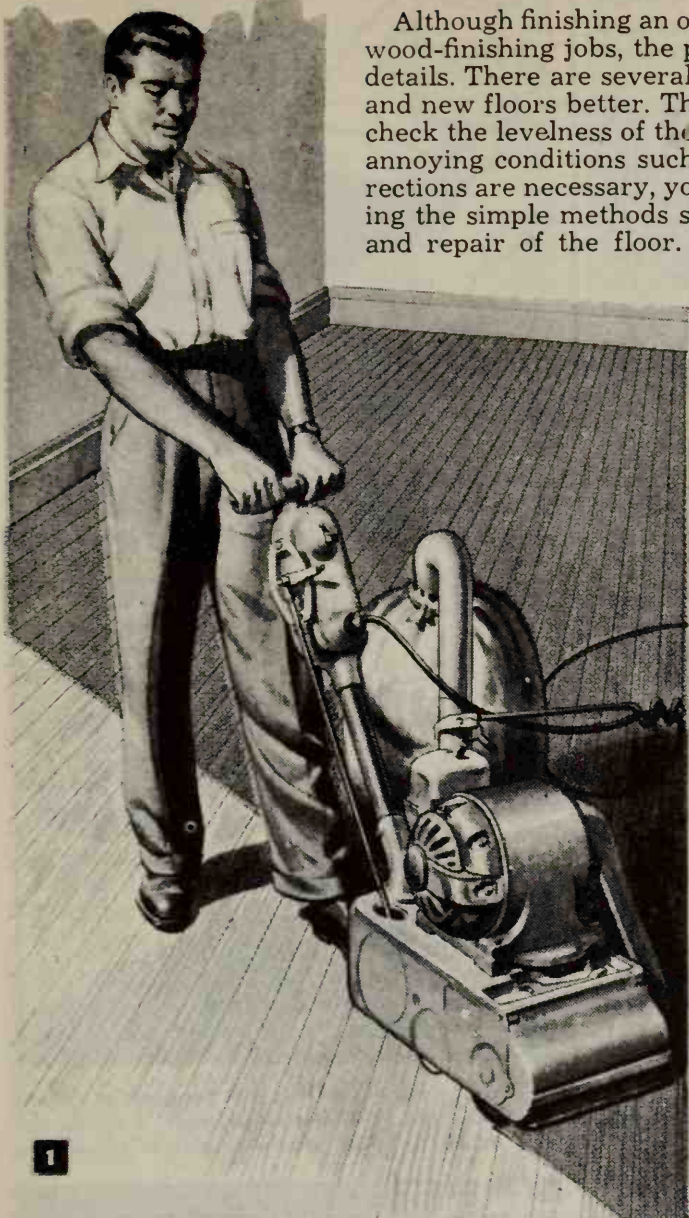
Mix enough filler for one room at a time and work small areas until you have experienced wiping the filler. As silica in the filler is heavy and sinks, stir filler before application

FINISHING A HARDWOOD FLOOR

Although finishing an old or new floor is one of the simplest wood-finishing jobs, the process calls for careful attention to details. There are several methods of making old floors new, and new floors better. The first step in either operation is to check the levelness of the floor and to correct any faulty and annoying conditions such as squeaks and sags. If these corrections are necessary, you can do the job yourself by following the simple methods suggested in the section on the care and repair of the floor. When the adjustments have been made, the floor can be cleaned and prepared for finishing.

Finishing either old or new hardwood floors requires the same procedure except that on an old floor you sometimes add one more step, that of removing the old finish. Some finishers take off the old varnish first with a paint and varnish remover. This will save time when sanding floors which have been varnished several coats. However, in most cases where the floor has been finished in the usual way, removal of the varnish before sanding is not necessary. The first step on either old or new floors is to smooth and fill the bare wood. On new floors this should be done before the floor has been walked on or exposed too long to changes of temperature and humidity. Dust, which settles and becomes embedded in the open grain of the wood by the action of moisture darkens the surface.

Sanding: On both new and old floors the edges of the boards will be slightly raised, due to shrinkage and also the clearance in the joints. This wavy surface can be noted by passing the palm



of your hand over the floor. Although these raised places can be removed with a hand scraper as was the regular practice in older methods, a much faster way is to go over the floor with a sanding machine.

There are several types of sanding machines available on a rental basis and you will need two of them. The drum-type machine, Fig. 1, is used for preparing the open area of the floor to within 2 or 3 in. of the baseboards, while the disk-type edger, Fig. 2, is designed to finish this remaining strip. It is best to remove the shoe mold before using this machine. If there are radiators in the room, these also should be taken out. Remove the finish from an old floor with a coarse abrasive on the sanding drum. Then use a medium grit for smoothing out the scratches left by the first abrasive and finally finish with a fine-grit abrasive. On a new floor in good condition, the coarse sanding is not necessary.

In the operation of these machines, it is essential to keep them in motion while the abrasive is in contact with the floor. Otherwise the abrasive will dig in. Speed of movement over the floor is not as important as uniformity. When operating the drum-type machine keep it in motion and raise the drum from the floor when you reach the baseboard. Roughing (first sanding) can be done in any direction, with the grain or across the grain. Most floor finishers run the machine at an angle of 45 deg. for the first sanding, as shown in Fig. 1. The rough sanding removes the old finish and evens up the individual floor boards. When finishing with the medium and fine abrasives, sanding is always done with the grain. Use coarse, medium and fine disks on the edger also, so that you get the same uniformity of finish all the way to the baseboards.

Scraping: There are always some spots you cannot reach even with both sanding machines, such as around radiator pipes, sink drains, and a small area in each corner of the room that the shoe mold will not cover. Here the old finish must be removed and the wood smoothed with a hand scraper, Fig. 3. Care must be taken when scraping around water pipes, as the wood is nearly always discolored. It's important to remove all this discoloration as otherwise it will show up with greater emphasis when the floor is finished. To remove this discoloration, there are several types of bleaching compounds that are considered effective. Some bleaching solutions will remove the natural color from any kind of wood, if this is necessary.

Dusting: When the floor has been thoroughly sanded and scraped, dust off all window stools and frames, all doorframes,



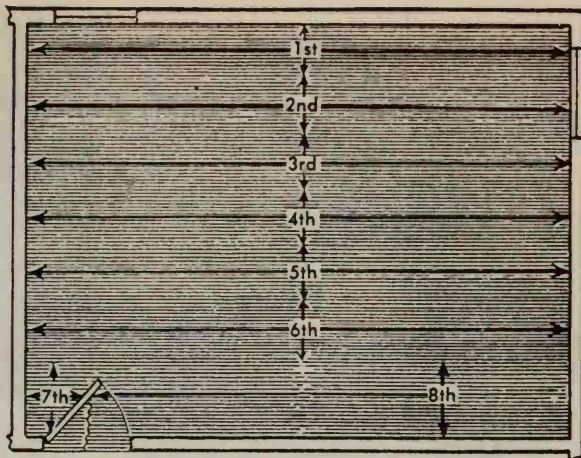
The filler should be reduced with turpentine to a light creamy consistency. Stir thoroughly to dissolve all lumps, and stir the mixture occasionally while using



Some finishers apply the filler with the grain as shown; others insist that it is better to apply it across the grain, as this method promotes greater absorption



Filler should always be rubbed in across the grain with a coarse cloth. Double the cloth several times to make a soft pad which will pick up excess material



Above and left, apply sealers and varnish with long strokes, using a wide, well-filled brush. Begin in the corner farthest from the door and apply a strip about 2 ft. wide all the way across the room. Finish to the door with successive varnished strips of equal width

doors and baseboards. Use a painter's tack rag for this as it picks up dust without scattering it about. Dust the floor thoroughly with the same cloth. Frequent dusting while the finishing process is going on is important. If light dust accumulates in the room air movement may dislodge it. Floating dust particles always settle on the freshly varnished surface, and cause flecking and spotting of the finish.

Filling: All porous woods must be filled. Some finishers prefer to apply a light oil stain before filling, to give the floor an even color tone. Others mix the stain with the filler. On a new floor this latter method is faster and gives good results, but on either old or new work, the former method generally is considered the best practice. In either case, a small quantity of stain is added to the filler, Fig. 4, to prevent it from lightening the natural color of the wood after application. Filler should be applied with a brush, in the direction of the grain, as in Fig. 5, and then rubbed crosswise of the grain with burlap or other coarse cloth, as in Fig. 6. Continue rubbing until the filler begins to set or flatten, which it will do after a few minutes. Keep the excess material wiped off as you go along. A few drops of turpentine on the cloth will help to remove excess filler that sticks tightly in spots. After applying, allow the filler to dry for 24 to 36 hours. Then go over the floor with fine steel wool, rubbing at an angle with the grain, to remove all traces of filler that have hardened on the surface.

Varnishing: Although not necessary, it's best to first cover your shoes with cloth boot socks before you step on the floor. A smudge from a rubber heel is difficult to remove. Next, apply a floor sealer with a

wide brush. Start in a corner and work a strip from one side of the room to the other, Fig. 7, laying on the material with a full brush and with the grain of the wood. After allowing this coat to dry in a temperature of 68 to 70 deg., smooth with fine steel wool and dust thoroughly. Follow with one coat of high-grade floor varnish. Flow on the varnish coat with a full brush, covering narrow strips successively, as in the detail at the right of Fig. 7. Finish up at the door. Allow this coat to dry for a longer period than the first, and then smooth again with fine steel wool. If, after drying, the floor shows a dull spot here and there where the wood grain has taken up the finish, you will need to apply a third coat. Usually, however, one coat of sealer and one of varnish are ample on a well-filled floor.

Waxing: Wax protects against scratches because it provides a "slip" surface. Grit, shoe nails, toys or other sharp objects tend to slide over a waxed surface without gouging or scratching. However, a rubbed and polished wax coating is slippery and rugs placed on such a floor may be the cause of injury to someone from falling. Avoid this danger by using a "self-polishing" wax which gives a pleasing gloss without being slippery.

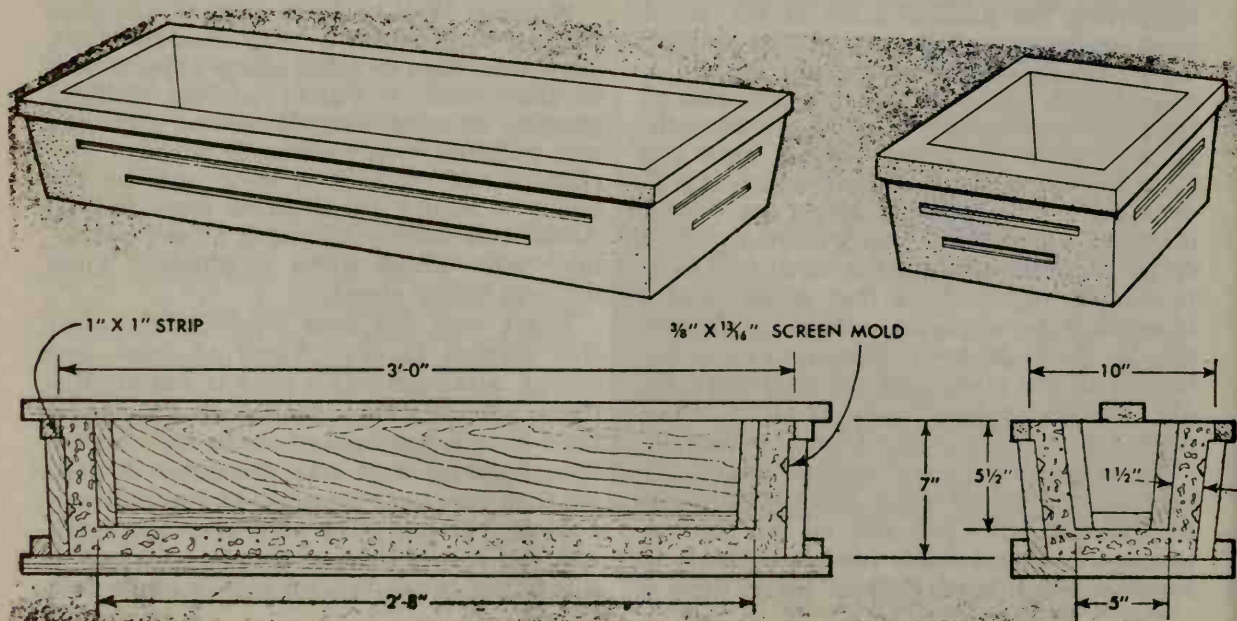
Don't wax the floor immediately after the varnish is dry. Allow at least two weeks, although more time is better. If a paste wax is used, apply it to the sealed floor in thin applications with a cloth pad. Two light coats of wax are easier to polish than one heavy coat. Like sanding machines, wax-polishing machines are available on a rental basis. Some polish with a rotating brush, others with a cloth belt.



FLOWER BOX

REQUIRING only inexpensive materials and easily constructed forms, this attractive concrete flower box will provide a distinctive and durable ornament for mounting beneath a window or along the porch railing of your house. Consisting of an inside and outside form, the forms are assembled from 1-in. stock, in any length or width desired. Both forms are sanded smooth and finished with two or three coats of shellac to prevent warping. The inside form, built to provide 1½-in.-thick concrete sides and bottom, is carefully centered when set in the outside form prior to the pouring of concrete. All surfaces that will come in contact with the concrete are oiled to pre-

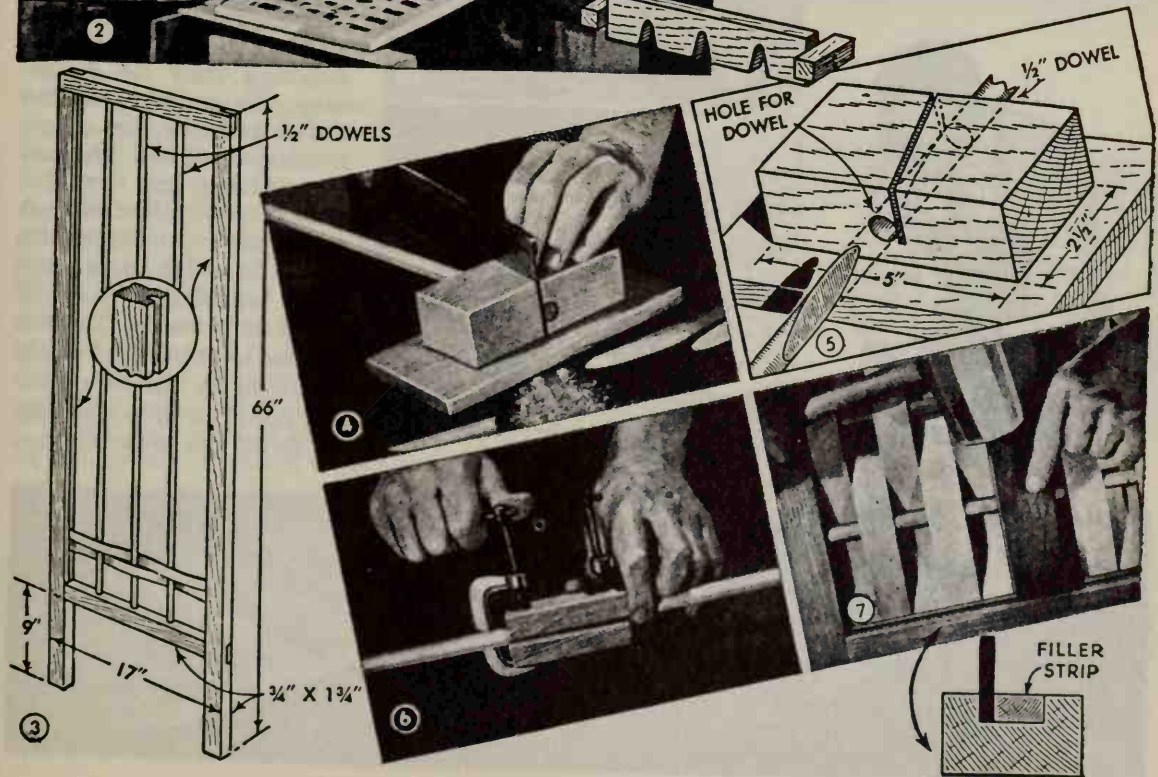
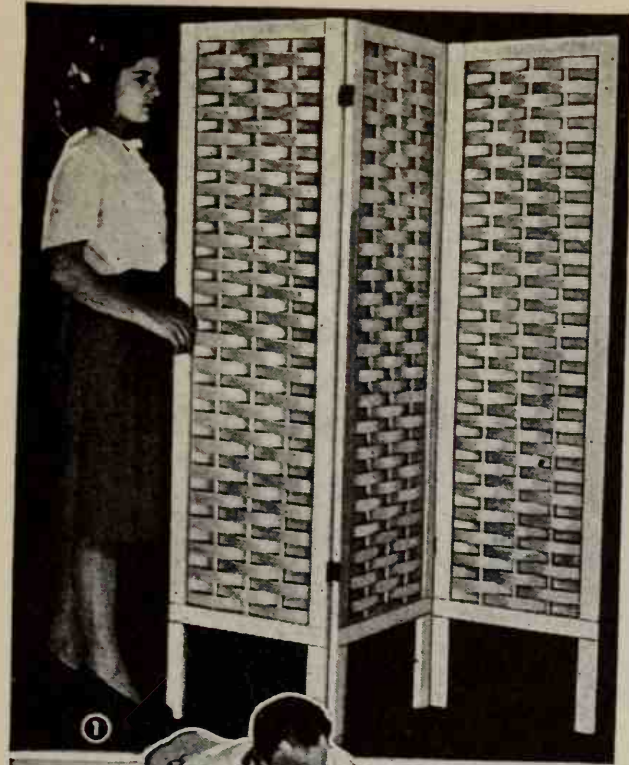
vent concrete from sticking to the sides of the forms as they are being removed. During the pouring operation, concrete should be tamped into all corners, as well as around any strips of molding or blocks of wood mounted inside the forms to create various decorative effects. The concrete is allowed to harden for 24 hours before the forms are removed. Following this, all voids and other irregularities are filled with a thick, creamy mixture of portland cement and water. The entire box is then coated with this mixture. When this is done, the box is permitted to cure for one week, during which time it is given a thorough wetting each day.



FOLDING SCREENS

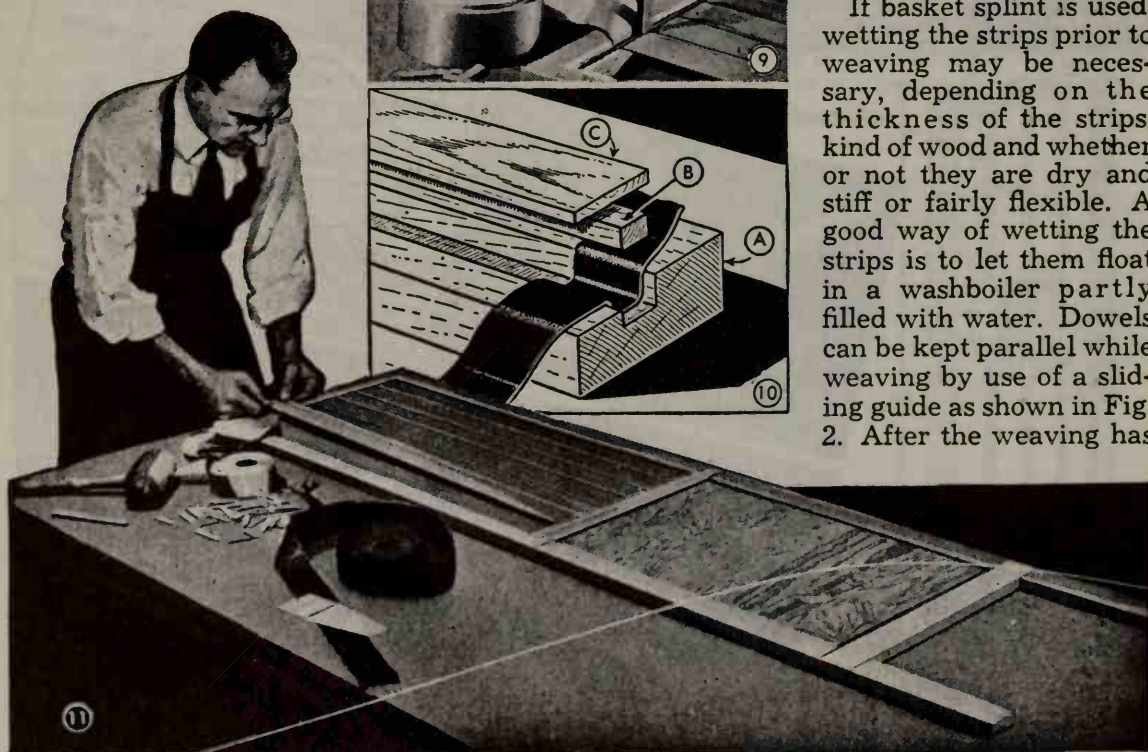
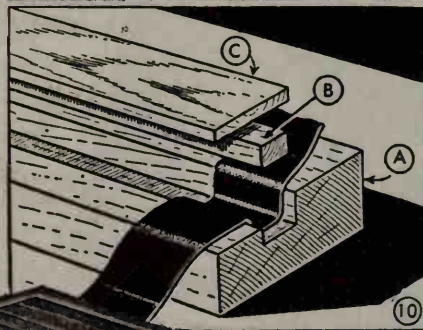
FLOOR screens are not only useful and attractive, but they are interesting projects to make. The dimensions and number of sections of a screen can be varied to suit. Each of the three sections of the screen shown in Fig. 1 is made by weaving basket splints between dowels set vertically in a wooden frame. Basket splint can be purchased, or you can rip it on a circular saw. If desired, very unusual effects also can be worked out with strips of thin plywood, linoleum, fiber board, sheet plastic or other durable, flexible material.

Fig. 3 shows the construction and dimensions of the screen sections. The facing edges of the vertical members are grooved as indicated. If dowels of the required length are not obtainable, shorter pieces can be spliced together. A glued,



diagonal splice is strong and easy to make, particularly if a miter box like the one shown in Fig. 4 is used. It is a block of scrap wood with a hole drilled through it and a saw cut made as shown in Fig. 5. The block is nailed to a suitable base. When gluing up the diagonally-cut ends of dowels, hold them in alignment by means of two grooved blocks as in Fig. 6. Place waxed paper in the grooves so that glue extruded by pressure of the clamps does not cause the blocks and dowels to stick together. After the glue has dried and the sticks have been cut to the correct length, they are secured in the frames, their ends being forced into sockets drilled in the horizontal members.

The next step is weaving in the flexible strips. You can save time by fitting the first strip accurately and then using it as a template to cut a supply of similar strips. To fit correctly, the ends of a strip must butt against the bottom of the grooves, and it must be in contact with all three dowels. If it is

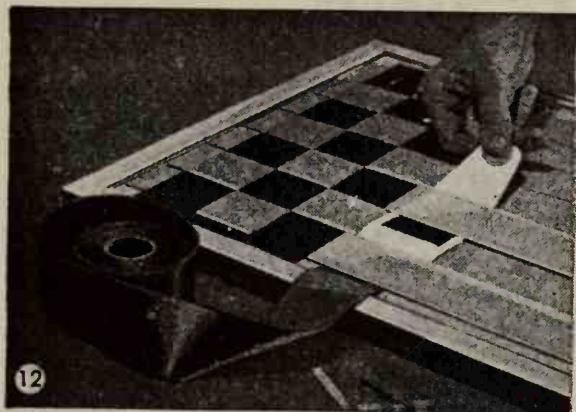


too long, it will stand away from one or more of them.

If basket splint is used, wetting the strips prior to weaving may be necessary, depending on the thickness of the strips, kind of wood and whether or not they are dry and stiff or fairly flexible. A good way of wetting the strips is to let them float in a washboiler partly filled with water. Dowels can be kept parallel while weaving by use of a sliding guide as shown in Fig. 2. After the weaving has

been finished, anchor the ends of the splints in the grooves of the frames by forcing filler strips into the grooves as shown in Fig. 7. Apply glue to the strips before driving them into place.

The three sections of the screen are fastened together with four double-acting hinges especially designed for use on screens of this type. If such hinges are unavailable, you can make two-way hinges of webbing or leather as shown in Fig. 14. Two pieces of webbing form one hinge. Each piece is attached to one side of one frame, and to the opposite side of the adjacent frame. The webbing is inserted into openings made in the frames and is held in place by tight-fitting wedges glued into the openings. The finish given the completed screen is governed by furnishings where it will be used, and by the material from



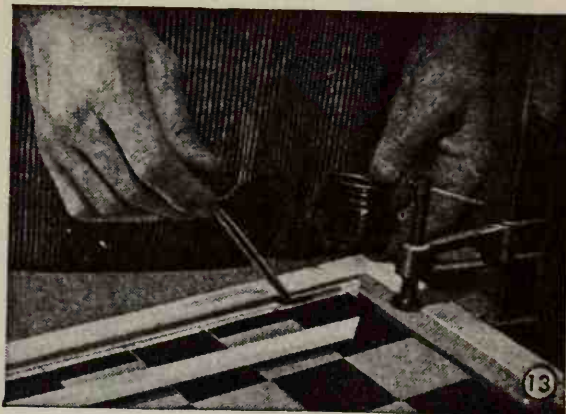
which it is made. The screen described was made of basswood splints in pine frames, finished with two coats of clear shellac.

Fig. 8 shows a two-section screen, each section being a frame consisting of two vertical members with three horizontal members jointed into them. Stock dressed to $\frac{3}{4}$ by $1\frac{3}{4}$ in. is used. A panel of $\frac{1}{4}$ -in. plywood glued into grooves forms the lower part of each section, the panel being decorated with a rectangle of $\frac{1}{2}$ -in., half-round molding nailed and glued in place.

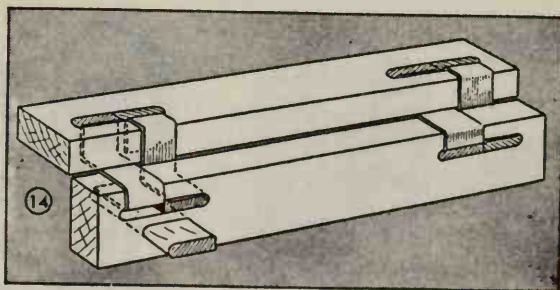
The upper part of each section is made of two colors of ribbon woven into a checkboard pattern. Before gluing up a frame, dado the portions of the vertical and horizontal members to which the ribbon will be secured so that they have a shape like piece A in Fig. 10. The surfaces of the members between the grooves and the inner edges (the left-hand portion in the detail) are cut down $\frac{1}{8}$ to $\frac{3}{16}$ in. lower than

the surfaces toward the outer edges. Make a hardwood strip, B, and cut it into pieces of the same length as the width of the ribbon. Then, cut a thin piece, C, wide enough to cover both the strip and the low-surface side of the member.

Lay one end of the ribbon in the groove



and anchor it in place by driving in one of the hardwood pieces as in Fig. 9. Pull the ribbon tautly across the frame, Fig. 11, secure it in place in the same way on the other side, and then cut it off with a razor blade. Put all the long, vertical strips of ribbon in place before weaving in the short horizontal ones. To weave in the hor-



izontal strips, you can improvise a "needle" from stiff cardboard and use it as in Fig. 12. After the weaving is complete, miter the corners of the flat strips and glue them in place, Fig. 13. This screen is hinged in the same way as the one first described.

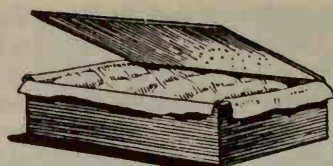
Meats

MEAT SHOULD BE KEPT AT 0° F. OR LOWER

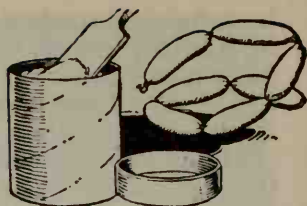


FEBRUARY						
S	M	T	W	T	F	S
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

BEEF SHOULD HANG 4 OR 5 DAYS BEFORE FREEZING

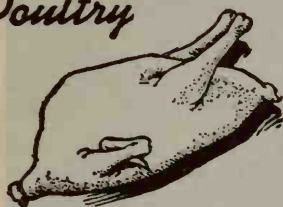


CARTONS FOR MEAT SHOULD BE LINED WITH MOISTURE-PROOF VEGETABLE PARCHMENT PAPERS



HEAVILY WAXED CONTAINERS ARE IDEAL FOR GROUND MEATS

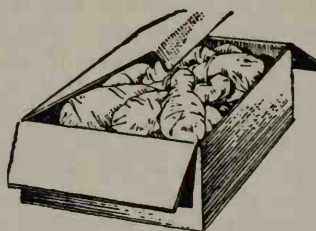
Poultry



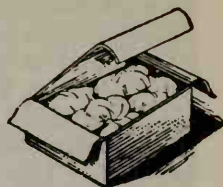
WHOLE FOWL IS DIFFICULT TO WRAP SNUGLY ...



... IT'S BETTER TO DISJOINT IT AND WASH PIECES IN COLD WATER ...



... THEN WRAP INDIVIDUALLY IN MOISTUREPROOF PAPER AND PACK IN CARTON



WRAP GIBLETS SEPARATELY

FOOD FREEZING

WHILE prompt handling has much to do with success in storing foods in home freezers, it's equally important that you know how to process and, especially, package them to retain as much of the flavor and nutritive value as possible. Generally, the right time to prepare fruits and vegetables is when they are ready for immediate table use. They should be gathered in the early morning before they absorb the day's sun and should be processed and frozen with as little delay as possible. Loss of vitamin value occurs rapidly at room temperature, and holding products over to

the following day should be avoided, especially after shelling, scalding or cutting. It should be remembered that freezing does not necessarily sterilize the product. Consequently, it is important that all utensils as well as the hands be thoroughly clean before preparing the food.

In most cases, a storage temperature of 0 deg. F. will give satisfactory results when just a few packages of food are to be frozen at one time. Large amounts will require a lower temperature of -10 deg. F., although it's best not to try to freeze too many packages at once. As it is not as cold near the

Milk

FROZEN MILK WILL KEEP ONE OR TWO MONTHS

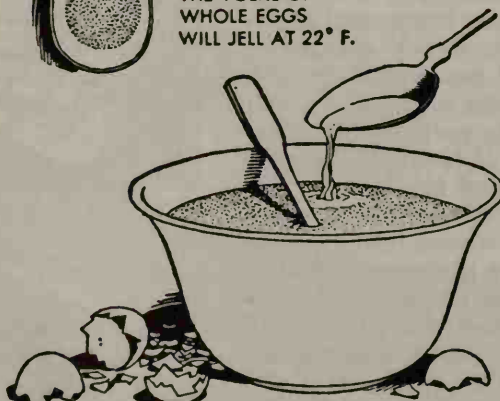


CREAM IS NOT GOOD AFTER FOUR MONTHS



Eggs

THE YOLKS OF WHOLE EGGS WILL JELL AT 22° F.



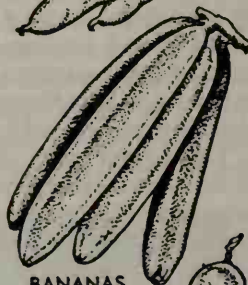
IT'S BETTER TO BREAK THEM AND STIR YOLKS AND WHITES TOGETHER ADDING 5% CORN SYRUP, SALT OR SUGAR

THESE ITEMS REQUIRE

SNAP BEANS

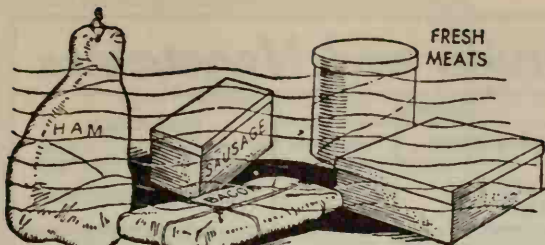


BANANAS



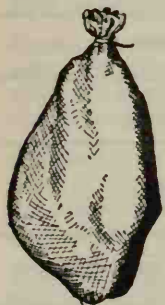
PEARS





FRESH MEATS

SMOKED MEAT WILL IMPART FLAVOR TO FRESH MEAT IF STORED CLOSE TO IT



IF STORED WHOLE, STOCKINETTES WILL KEEP THE MOISTURE-PROOF PAPER CLOSE TO THE FLESH



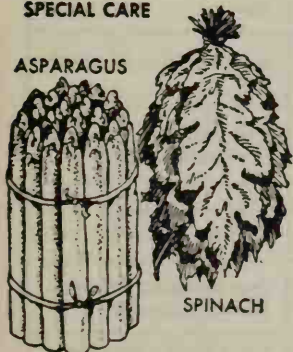
Label and date each package for future identification. A waxed school crayon or grease pencil is just the thing for marking packages

top of the freezer, always check the temperature at this point. A periodic check should be made to detect possible power failure or mechanical breakdown. Should such an event occur, little thawing will take place during the first 15-20 hours. After this time it is best, if possible, to move the food to a locker plant or use dry ice to prevent excessive thawing until freezing is resumed. As a precaution against lowering the temperature too greatly, use dry ice sparingly. The length of time that products may be stored depends upon the temperature maintained. At 0 deg. F. fruits and vegetables may be stored 10-12 months,

while at 5 deg. F. the period is shortened to 8-10 months. In the case of meat, much is dependent upon the length of time it is held prior to freezing. Beef requires at least 4 or 5 days in a cool place for aging before it is cut up and packaged. Lamb, pork and veal should be frozen as soon as it is thoroughly chilled. Pork, especially, should be kept at a low temperature as it oxidizes easily and becomes rancid at higher temperatures. Dipping pork cuts quickly in hot lard will seal them and help prevent drying out during storage. Frozen meats should always be thawed thoroughly before cooking, especially large roasts, oth-

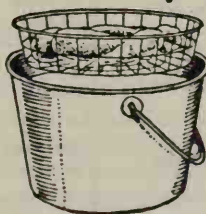
SPECIAL CARE

ASPARAGUS



SPINACH

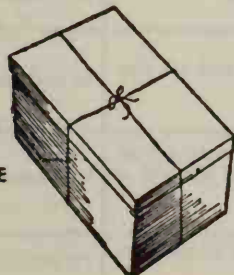
Vegetables



BLANCH IN BOILING WATER AND CHILL TO 50° F. →



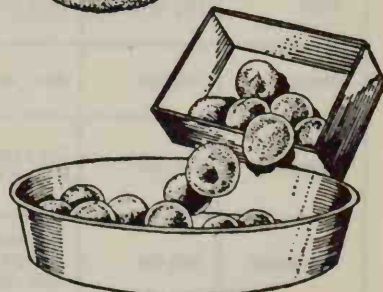
... THEN FREEZE AND STORE AT 0° F.



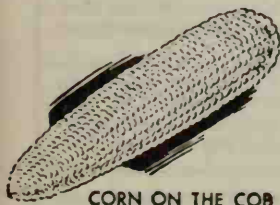
Fruits



FRUITS TO BE FROZEN SHOULD BE PICKED AT THE SOFT-RIPE STAGE



CHERRIES AND BERRIES SHOULD BE WASHED IN ICE WATER



CORN ON THE COB

A Guide for Freezing Fruits and Vegetables

Product	Maturity Desired	Preparation	Scalding		Type of Pack
			Boiling Water	Steam	
Asparagus	Tender tips best	Trim, wash, and discard all but upper 6 inches	Small stalks: 3 min. Large stalks: 4 min.	3½ min.* 4½ min.*	Without brine
Lima beans—bush or pole	Green beans best	Shell	Medium beans: 1½ min.* Large beans: 2 min.* Small beans: 1 min.*	2½ min. 3 min. 2 min.	Without brine
Soy beans	Green beans best	Scald pods, shell	2 min.*	3 min.	Without brine
Snap beans	Small beans best	Snip; cut into ¾-inch lengths	2 min.*	3 min.	Without brine
Beets	Young and tender	Cut off tops; mature beets should be cooked, then rub off peels; slice	1½ inches in diameter: 2½ min. Over 1½ inches: cook until tender	3½ min.* Cook until tender	Without brine
Peas	Sweet and not starchy	Shell, discard starchy peas	Small peas: 45 sec.* Large peas: 1 min.*	1½ min. 2 min.	Without brine
Spinach	Young	Cut and discard thick stems	2½ min.*	3½ min.	Without brine
Sweet corn, on cob	Before starchiness develops	Husk; don't use immature and overmature ears	Small ears: 6 min. Medium ears: 8½ min. Large ears: 10½ min.	6½ min.* 8½ min.* 10½ min.*	Without brine
Sweet corn, cut	Before starchiness develops	Scald on cob as directed above, cool, then cut off whole kernels; or cut whole kernels from cob, then scald	Not recommended	2½ min.*	Without brine
Swiss chard	Small leaves best	Cut off and discard main stem	2 min.*	3 min.	Without brine
Apples	Fully mature	Peel, slice in 12ths	Not recommended	1½ min.; cool	Dry (no sugar or sirup)
Blueberries	Fully ripe	Stem, wash, crush slightly	Not recommended	Not recommended	4 or 5 pounds fruit to 1 pound sugar
Cherries, sour	Fully ripe	Wash, chill, pit	Not recommended	Not recommended	3 pounds fruit to 1 pound sugar
Gooseberries	Fully ripe	Stem, wash, crush slightly	Not recommended	Not recommended	3 pounds berries to 1 pound sugar
Peaches	Fully ripe	Peel, pit, slice	Not recommended	Not recommended	Cover with 60 or 70 percent sirup**
Pears	Fully ripe	Peel, core, quarter	Not recommended	Not recommended	Cover immediately with 60 or 70 percent sugar sirup**
Plums	Fully ripe	Wash, pit, quarter	Not recommended	Not recommended	Cover immediately with 60 or 70 percent sugar sirup**
Prunes	Fully ripe	Wash, pit, quarter	Not recommended	Not recommended	Cover immediately with 60 or 70 percent sugar sirup**
Raspberries	Fully ripe	Sort, wash in ice water, hull; crush or leave whole	Not recommended	Not recommended	4 or 5 pounds crushed berries to 1 pound sugar; cover whole ones with 50 or 65 percent sugar sirup**
Strawberries	Fully ripe	Sort, wash in ice water, hull and slice one quarter inch thick or leave whole	Not recommended	Not recommended	4 or 5 pounds sliced berries to 1 pound sugar; cover whole berries with 50 or 65 percent sugar sirup**
Rhubarb	Early spring best	Eliminate leaves; cut into 1-inch lengths	1½ min.*	2 min.	Without sugar or sirup if desired

*Indicates preferred method.

**For preparing sirup see table page 191.

New York State Agricultural Experiment Station.

Preparation of Sirup For Freezing Fruits

Dissolve the sugar in boiling water or mix the sirup with boiling water; cool to room temperature.

50-percent sirup: 2½ cups sugar per pint of water; 3 cups water to 4 cups crystal white corn sirup; 3½ cups water to 4 cups high-grade confectioners' corn sirup.

60-percent sirup: 3½ cups sugar per pint of water; 1½ cups water to 4 cups crystal white corn sirup; 2 cups water to 4 cups high-grade confectioners' corn sirup.

65-percent sirup: 4½ cups sugar per pint of water; ½ cup water to 4 cups crystal white corn sirup; 1½ cups water to 4 cups high-grade confectioners' corn sirup.

70-percent sirup: 5½ cups sugar per pint of water; ¼ cup water to 4 cups crystal white corn sirup; 1 cup water to 4 cups high-grade confectioners' corn sirup.



A moderately hot household iron, applied for a few seconds, will seal "bag-in-carton" containers. Cellophane bags may be sealed with a curling iron, taking care not to burn them

erwise the meat will not cook uniformly.

The importance of doing a thorough and careful job of packaging cannot be over-emphasized. The wrapping material used not only must protect the food from loss of moisture, but also must prevent transfer of odors. Ordinary waxed paper is not sufficiently moistureproof to package meat satisfactorily. In addition to special moistureproof paper for wrapping frozen foods, there are Cellophane, Pliofilm and rubber-latex bags which provide excellent protection. Present recommendations are that the size of the packages should not exceed 2 lbs. per package for fruits and vegetables and a package weight of 5 lbs. for chilled meats is about right. Roasts and other cuts of meat should be wrapped tightly to make them as airtight as possible and securely sealed with cellulose tape or tied with twine. Two separate wrappings, of course, are better than one. An outer covering of mesh cloth known as a stockinette will serve to protect the wrapping. Small cuts of meat are stored best in containers lined with moistureproof paper. To exclude as much air as possible, containers should be packed to the very top. Vegetable and fruit juices must have room for expansion. Containers most commonly recommended for storing fruits and vegetables are heavily waxed cylindrical and square cartons, "bag-in-box" types and special moisture and vapor-resistant bags of Cellophane. In filling Cellophane bags the tops must be kept clean for later heat-sealing. This can be done with a household iron, or a curling iron if not too hot. There is less moisture loss with a double bag than a single one.

In blanching, or scalding, the vegetables are placed in a wire basket and lowered into boiling water for the required time as given in the table on the opposite page. They are chilled immediately afterward in running water 50 deg. F. and packed for storing. Fruits require a covering of sirup prepared according to the table above. The sirup should cover the fruit completely.

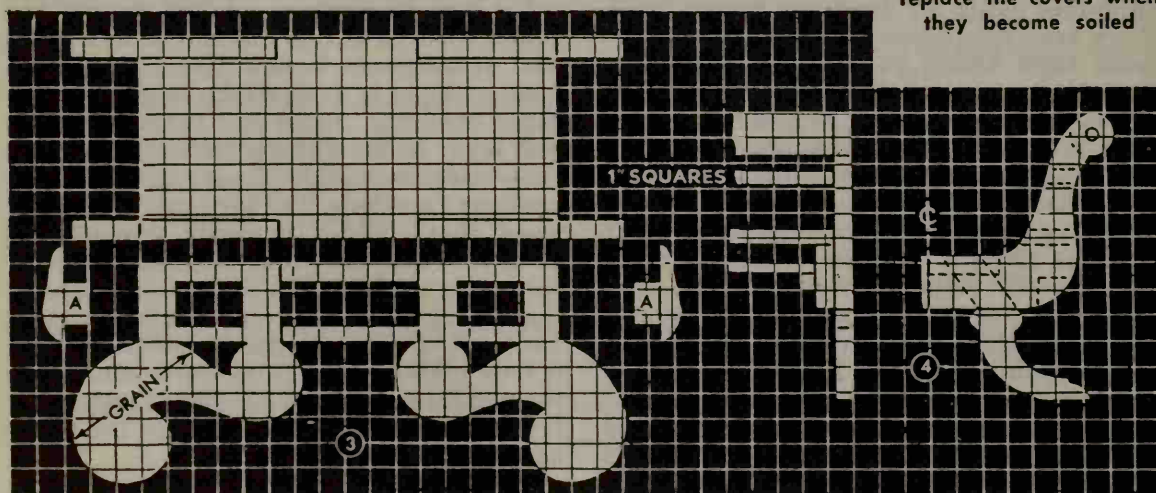
It's best to prepare poultry during the colder months as it is difficult otherwise to cool it properly before freezing. Unlike meat, poultry is more tricky to prepare because chickens, ducks and turkeys have a soft layer of fat directly beneath the skin that oxidizes quickly. It also is difficult to package the whole fowl because of the awkward shape which hampers wrapping it snugly. A stockinette, if available, helps to solve this problem, but it is recommended that the bird be cut up into smaller sections and each of these wrapped individually. As is true with meat, poultry never should be thawed for cooking by placing in water. Allow it to thaw gradually while in the package at room temperature.

FOOTRESTS

STURDY and easy to make, these two footstools are neat in appearance and have the advantage of being easy to re-cover when the cloth becomes soiled. The facing strips hiding the tacked edges of the covering material shown on the footstool in Fig. 1 can be easily and quickly removed so that re-covering the cushion is but a simple procedure. The cushion on the stool shown in Fig. 2 is removed simply by lifting out the complete pad. In keeping with the original American-Victorian style a wood frame of black walnut is recommended. Black walnut, especially, can be given a beautiful soft finish by hand-



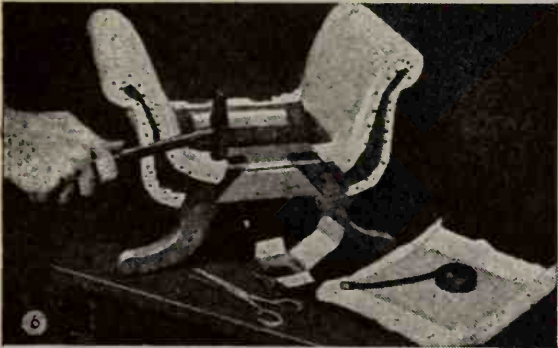
You can use light, gaily colored cloth covers on these footstools because it is a simple matter to replace the covers when they become soiled



rubbing several applications of linseed oil. Unlike most finishes the oil finish is in the wood, not on it, making the surface proof against ordinary wear and scratching. The lustrous, natural black-walnut finish will blend pleasingly with almost any figured material of the desired color you choose. The footstools illustrated here have been selected for their practical worth as well as their simplicity of design. The patterns

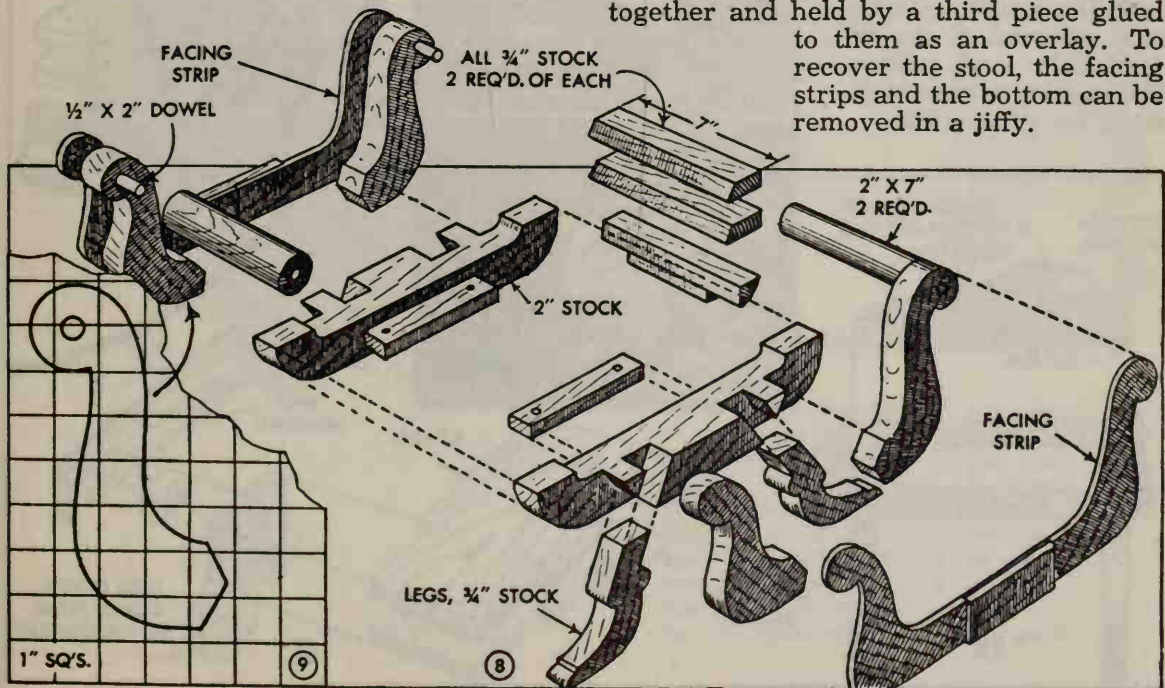
can be reduced or enlarged to meet with your particular needs.

The settee-type stool, Fig. 1, is unusually comfortable and restful to your feet, which are supported by the sides of the stool and thus prevented from turning outward with a resultant tiring twist of the leg muscles. Fig. 8 shows how parts are assembled, and Fig. 4 shows a half pattern of one of the sides. Each of these consists of two curved



vertical pieces cut to the size and shape shown in Fig. 9, and jointed to a third piece of 2-in. stock, which is notched to take them as well as the legs. Size and shape of the legs can be determined from the half pattern in Fig. 4. After gluing up the two sides, they are assembled together by a 7-in. length of 2-in. round stock and three wood strips across each end. These are shaped as indicated in Fig. 9, and are positioned as shown in the end view of Fig. 4. A cushion or bottom can be made by upholstering a piece of $\frac{1}{4}$ -in. plywood or hard-pressed board to rest on cleats, which are screwed to the inner surfaces of the stool sides.

After the framework of the stool has been assembled, the edges are sanded as in Fig. 5 to provide neat rounded corners over which to stretch the cloth covering. Special care should be taken when sanding the edges of the strips across the ends to see that the graceful curve of the sides is maintained. The stool is covered first with cotton flannel, putting the nap side out, Fig. 6. The fleeciness of the flannel tends to soften the outlines of the frame. To get a smooth fit, remove the bottom and tack the flannel under the inner edges of the end strips. The bottom is covered separately and is screwed in place later. After the flannel has been tacked in place, tack on the outer covering. This cloth must be drawn over the edges of the framework and tacked to the sides. Facing strips of $\frac{1}{4}$ -in. wood to match the legs are used to conceal the tacks as in Fig. 7. Each strip is made of three pieces glued together, two of which are the size and shape of the side half patterns in Fig. 4. These are butted together and held by a third piece glued to them as an overlay. To recover the stool, the facing strips and the bottom can be removed in a jiffy.



1" SQ'S.

9

8

The stool shown in Fig. 2 has legs jigsawed from $\frac{3}{4}$ -in. stock to the shape shown in Fig. 3. After the legs have been cut and sanded, they are screwed to a top consisting of two boards cut out at the corners to take them flush as in Figs. 10 and 15. Molding 4 in. wide on its flat surface is fastened to the sides and ends of the stool, the molding first having been mitered at the ends. The molding can be purchased or it can be made from standard crown molding as shown in Fig. 14. It is attached by means of small blocks glued and screwed to it as indicated in Fig. 15, and as shown at A in Fig. 3. The blocks are slipped between the top boards and also between openings in the upper parts of the legs as in Fig. 11. Screws driven down through the upper board of the top and into the blocks as in Fig. 12, hold the molding in place.

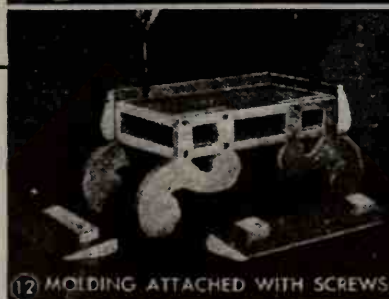
The cushion rests in a recess formed by the upper edges of the molding projecting above the stool top, and is made by tacking cloth to a piece of plywood or hard-pressed board and stuffing cotton batting between them, Fig. 13. A better way to make the cushion so it will have a smooth and symmetrical contour is to first place the batting on the board and then lay the cloth over it and tack it to the underside of the board, pulling the cloth taut as you proceed. Then the cloth is covered with figured material of the desired color and pattern. The cushion is easy to remove for recovering.



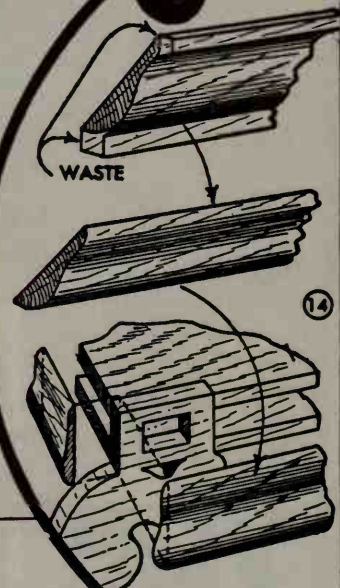
10 LEGS SCREWED IN PLACE



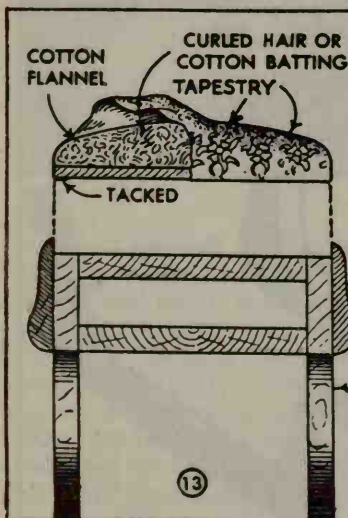
11 FITTING THE MOLDING



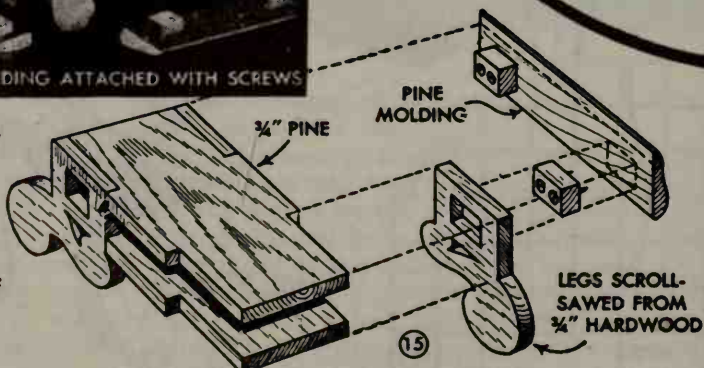
12 MOLDING ATTACHED WITH SCREWS



14



13

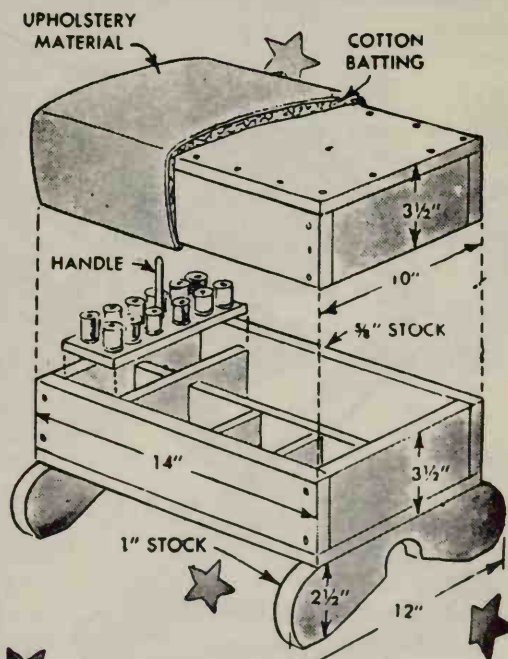


15

Novel Footstool Includes Utility Drawer For Mending, Slippers or Magazines



Easy to build and upholster, this attractive little footstool incorporates a convenient drawer for keeping slippers, mending, smoker's needs, etc. The stool is made from solid stock or plywood to the dimensions indicated, grooving the inside faces of the end members for the top and bottom members. The drawer bottom is a piece of $\frac{1}{8}$ -in. plywood or hardboard fitted in grooves cut in the front, sides and back. The cushion, which is screwed in place, is made by covering $\frac{1}{4}$ -in. plywood with cotton padding and sheet plastic or fabric. After completion, the footstool can be stained and waxed or painted a suitable color.

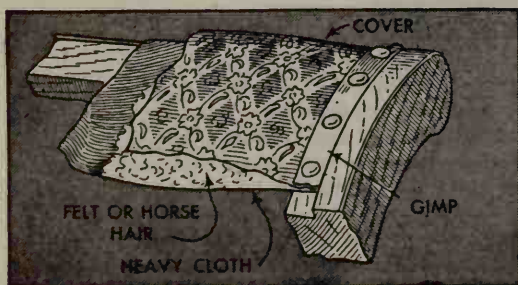
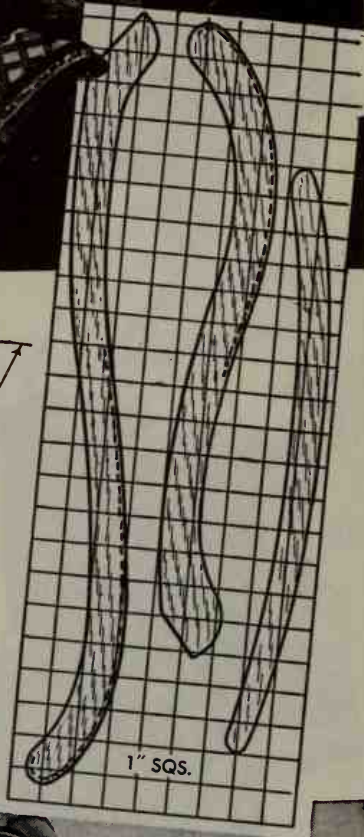
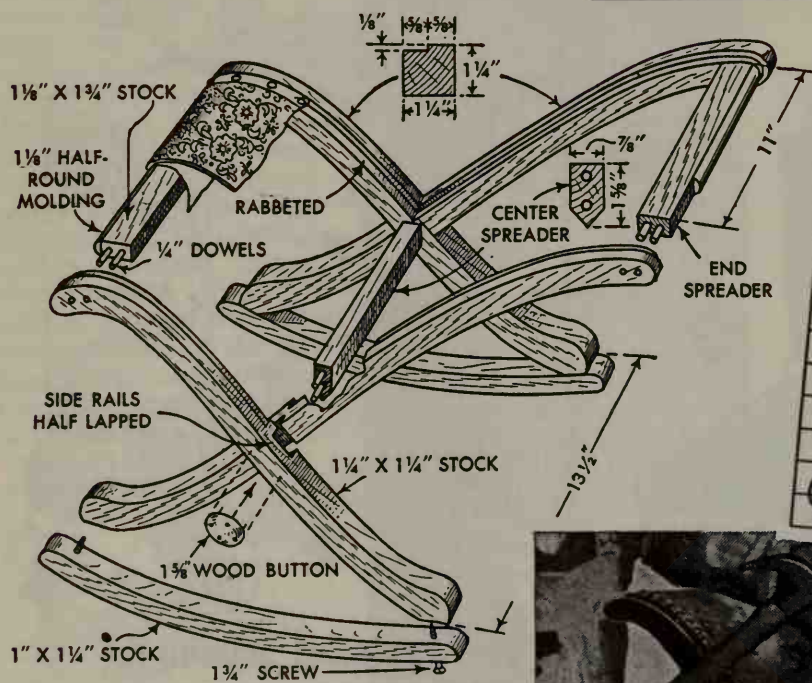


Footstool Sewing Kit

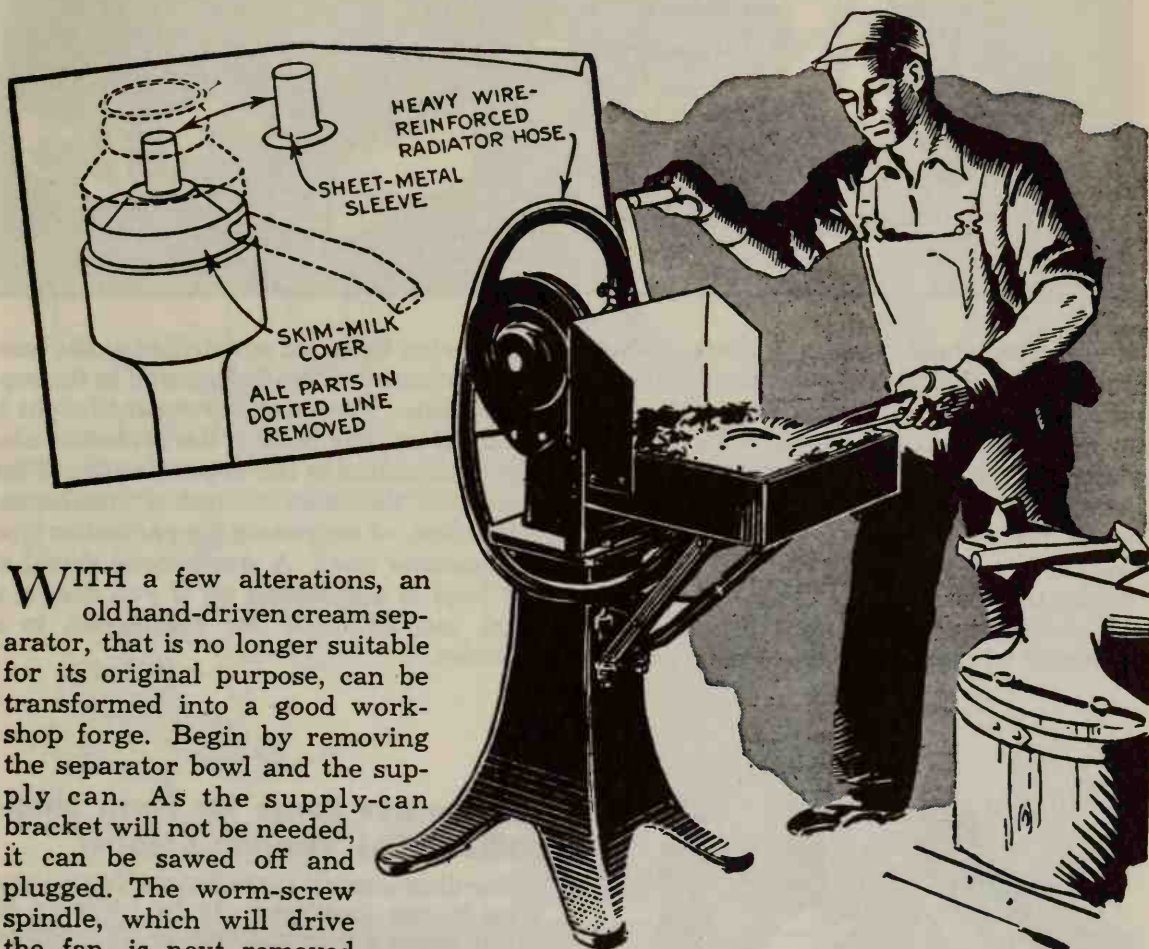
It's not just a footstool but a sewing kit, too. Raise the lid and you have a divided compartment for thread, pin-cushion, etc. Make a box with a top and bottom and saw it in half, length wise, to form the two parts. Pad and upholster both; hinge the lid and attach feet with screws in counterbored holes. The spool rack is made removable so that the space under it can be used.

FOOT ROCKER

YOUR feet always rest comfortably on this upholstered rocker because it automatically tips to the correct angle regardless of how you place your feet on it. The rocker consists of two X-shaped sides having rockers across the lower ends, the sides being tied together with three spreaders as indicated. After assembly, the rocker is finished as desired and then upholstered. This is a simple job. Just tack a piece of heavy cloth, face down, to the sides and spreaders, apply a thick layer of felt or horsehair and then another piece of heavy cloth, which is tacked to the sides and end spreaders only. Hiding the tack heads with gimp, held with decorative tacks, completes the job.



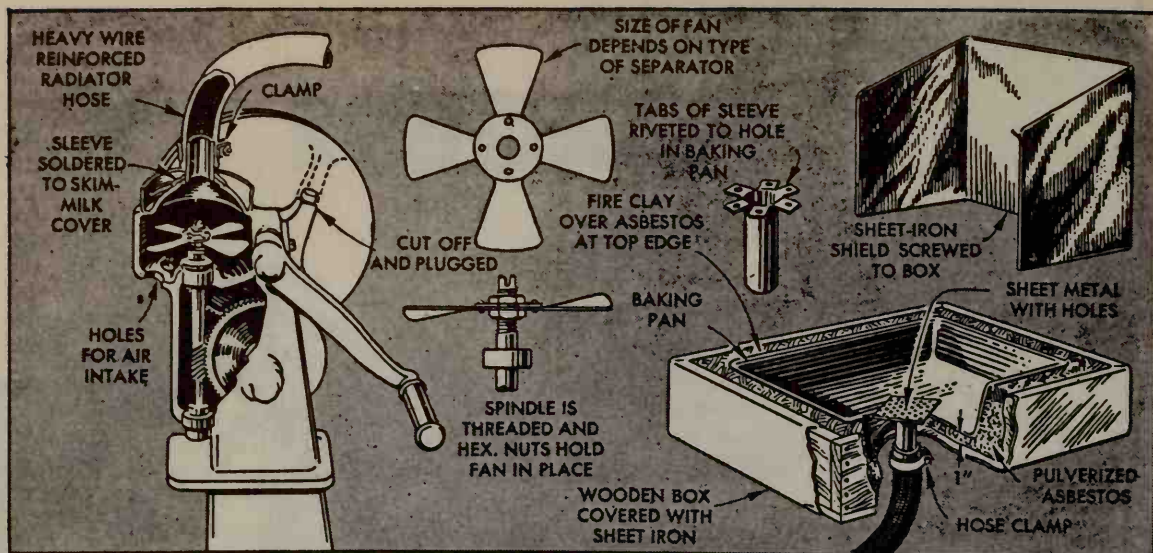
FORGES



WITH a few alterations, an old hand-driven cream separator, that is no longer suitable for its original purpose, can be transformed into a good workshop forge. Begin by removing the separator bowl and the supply can. As the supply-can bracket will not be needed, it can be sawed off and plugged. The worm-screw spindle, which will drive the fan, is next removed and threaded on the upper end. This is done by removing the dust cap and drip shield and then loosening the stop screw, which is located on the side of the frame. Lift the spindle straight up as the top bearing and spring will come out, leaving the lower ball bearing in position in the frame. The top bearing should not be removed from the spindle. Replace it as soon as the threading job is completed, and tighten the stop screw. The fan is cut from a piece of heavy sheet metal to the shape indicated, if a ready-made fan of the right size cannot be adapted. Dimensions are not given as these depend on the style of separator used. An extra piece of sheet metal is riveted to one side of the fan to make it sufficiently rigid, after which the fan is placed between two hexagon nuts on the spindle, so the fan will

direct the air current upward as it enters through the bowl casing drain. Extra holes may also be drilled in the casing to assure sufficient air intake. The spout is removed from the milk cover, it is placed over the fan, and a piece of 2-in. sheet-metal tubing is soldered to the opening in the middle.

The firebox is made of $\frac{3}{4}$ -in. white pine, lined on both sides with No. 22-gauge sheet iron. Pulverized asbestos is packed between the firebox frame and the inner box, which may be a heavy sheet-iron baking pan. The space between the pan and the outer box is then sealed with a layer of fire clay. The nozzle through which air is delivered to the fire consists of a 2-in. tube, which is connected with a length of wire-reinforced radiator hose to the sleeve on the milk cover, the hose being securely held



in place with hose clamps. A piece of sheet iron, perforated, is laid over the air intake of the firebox. When it is necessary to clean accumulated cinders from holes in this plate, merely loosen the clamp and slip the hose off. A still better arrangement is to use a tee instead of a sleeve, leading the hose to the side opening and fitting a plug in the bottom opening.

In mounting the firebox to the separator a couple of angle-iron braces are needed,

these being flattened and drilled at the ends for attachment to the firebox and to the separator base. The most convenient height is about 30 in. The back of the firebox is also rigidly attached to the upper portion of the separator, the exact method of attachment depending, of course, on the particular type of separator used. A sheet-metal shield at the back is also added or, if you desire, a hood can be made for connection to a chimney.



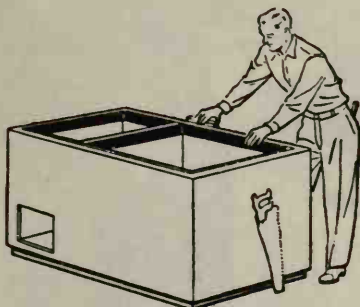
Inexpensive Forge for Farm Shop Utilizes Old Vacuum Cleaner

Needing a small forge for my farm shop, I made one inexpensively by utilizing an oil drum as a coke pit and an old vacuum cleaner as a bellows. A large opening was cut in one side of the drum and three channel-iron legs are welded to the bottom. Flat-iron cross braces welded between the legs formed a platform for the vacuum cleaner. I used a length of attachment hose to pipe the air from the cleaner to the coke pit.

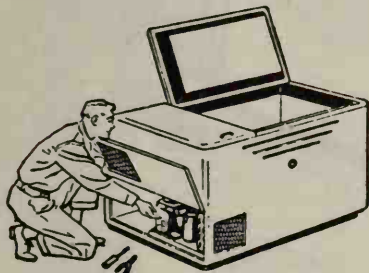


FREEZER UNIT

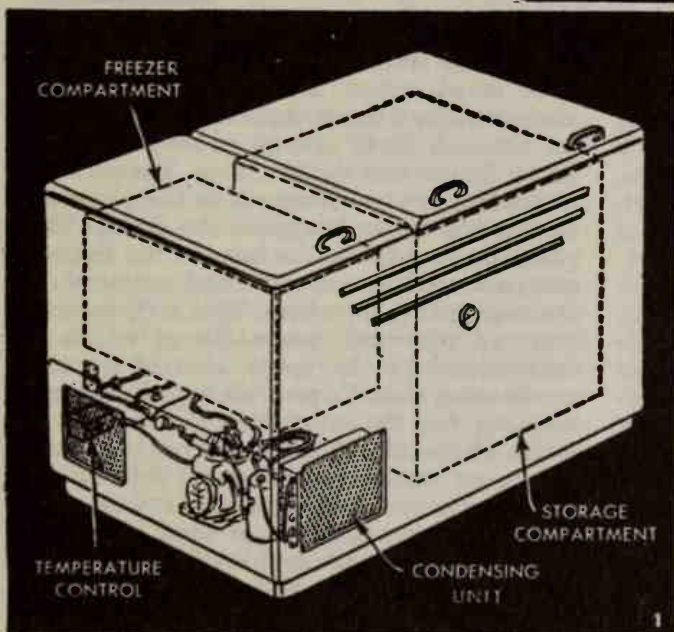
Ordinary hand tools were used in building this home freezer, which has 18 cu. ft. of storage space and a 2-cu.-ft. freezer compartment that has a separate control valve



You can make the unit smaller by reducing dimensions and size of condensing unit proportionately



Plans for constructing this freezer are available from Popular Mechanics Blueprint Department



BUILDING your own home freezer is not a difficult job, especially this one; it's nothing more than a well-insulated plywood box or cabinet in which a purchased refrigerating unit is installed. The freezer has been tested in actual use and also in a laboratory, Fig. 8. The freezer and storage compartments can be separately controlled by shutoff valves and the freezer compartment can be brought down to about 30 deg. below zero for quick freezing of meats and vegetables before putting them in the storage compartment. The latter is held at a temperature of approximately zero. When not in use, the freezer

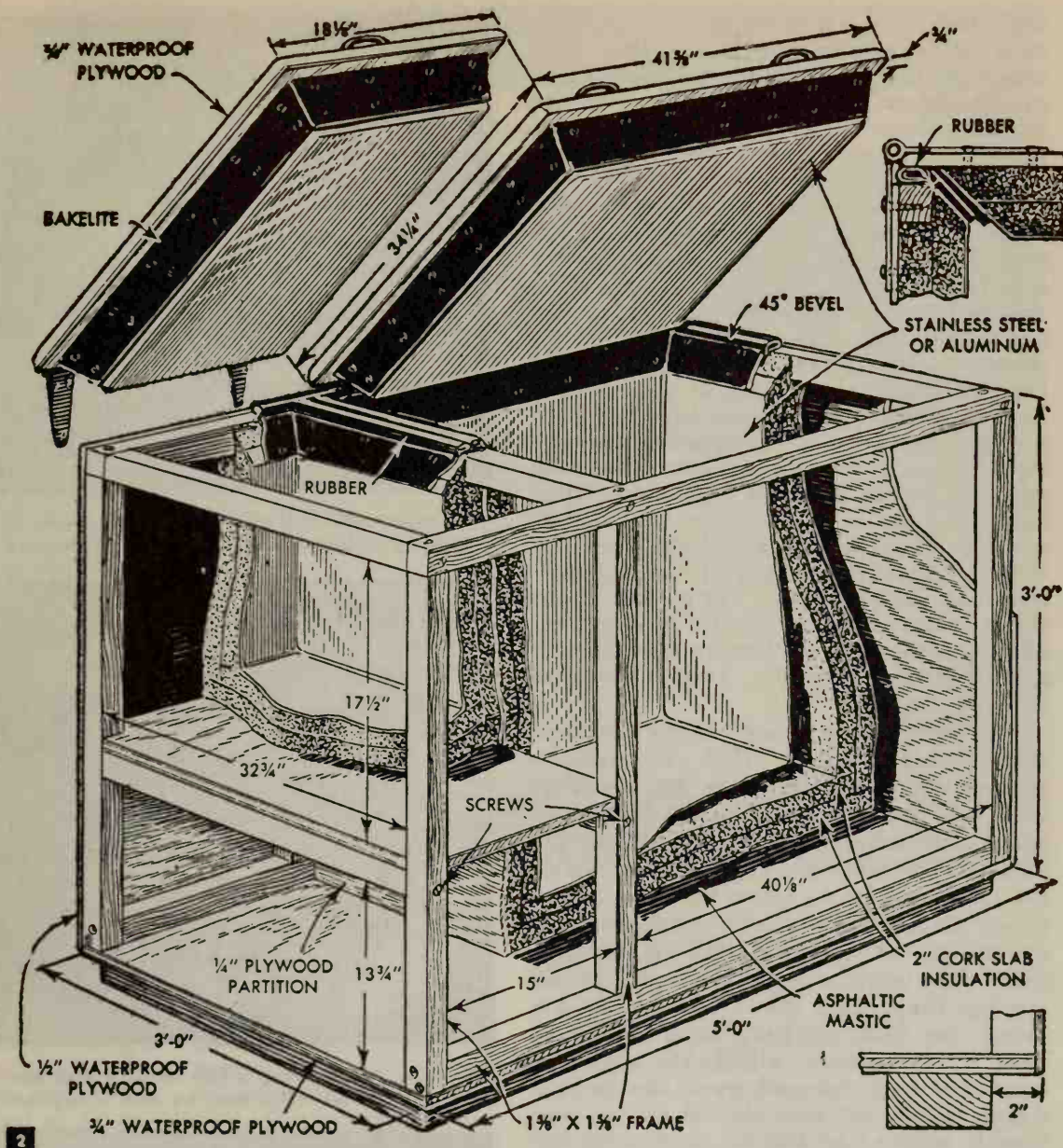


compartment may be shut off to ease the load on the compressor. It's best to use a new refrigeration or condensing unit, which comes charged with refrigerant and only has to be connected to the cooling or evaporator coils inside the compartments.

Construction begins with the cabinet, Fig. 1, which is divided into three parts: a freezer compartment, a storage compartment and the space for the condensing unit. Refer to Fig. 2 for the general dimensions. Since the over-all size of condensing units varies with different makes, this will affect the dimensions of the compartments because space allotted for the unit will vary. There should be several inches clearance on both sides and above the condensing unit. The dimensions given are for a hermetic $\frac{1}{3}$ -hp. unit.

After the base is cut, a 2 by 4-in. kick board is screwed to the underside 2 in. from the edges as shown in the lower right-

hand detail of Fig. 2. The corners are mitered. The frame is of glued-and-screwed butt construction and all members are common 2 by 2 in. stock, actually $1\frac{5}{8}$ by $1\frac{5}{8}$ in. dressed. They are glued and screwed, using No. 14 screws 3 in. long. The screws, of course, are countersunk so the plywood panels will fit flush against the frame. The platform that forms the base of the freezer compartment is cut next and screwed to the supporting members. This is $\frac{3}{4}$ -in. waterproof plywood, the width of which is determined by the space allotted for the condensing unit. To provide a partition and backing for the insulation for adjoining walls of the storage and freezer compartments, as well as to form one side of the condensing unit compartment, a $\frac{1}{4}$ -in. waterproof plywood panel is used. This extends the full width and height of the box and is fastened to the frame members against which it rests.



Next, the plywood sides, back and front are fitted to the frame. These are all $\frac{1}{2}$ -in. waterproof plywood, although hard-pressed board of a suitable thickness would do equally well. Before installing the front panel, cut an opening in it over the condensing unit compartment. Make the opening equal to the front area of the compartment and nail expanded metal over the inside of the opening. Any decorative grillwork can be used; but it must be remembered that air passing over the condenser enters through this opening and its area should not be restricted to retard movement of air as this would affect the efficiency of the refrigerating unit. That portion of the end panel covering the unit is hinged to provide a door for access to the unit. The door should be large enough to provide easy access to all parts of the com-

partment it covers. Toward the rear end of the door an opening is cut equal in area to the one in the front panel. This is the exhaust outlet for the condensing unit and remarks concerning the type of grille apply here as well as to the front panel.

After the panels have been fitted and assembled, they are screwed to the frame. Use flathead screws and countersink the holes so they can be filled. If the panels are cut so that one end comes flush with a corner frame member and the end of the adjoining panel extends slightly beyond the post, nicely rounded corners can be made. To do this, round the corners to the approximate curve desired with a plane or saw. Then use a sanding block that has the face cut to the desired contour to finish the curve. The lids for the deep-freeze and storage compartments should extend over

the openings about $\frac{3}{4}$ in. on all sides, with very little clearance between the inner edges of the two lids. Approximate overall dimensions are given in Fig. 2. After the lids have been cut to size, the corners and edges are rounded in the same manner as was done previously.

The next step is the application of the insulation and sheet-metal lining. A double layer of 2-in. compressed-cork slab, which is cut easily with a handsaw, is applied to the bottom and sides of both compartments and to the undersides of the lids. An asphaltic-mastic compound, which is a neat emulsified asphalt, is used as the bonding medium. Figs. 3 and 4 show how the mastic is troweled on. When applying the two layers of cork, spread mastic on all joining surfaces of the plywood and cork. After insulating the compartments and undersurfaces of the lids, roughly bevel the insulation at the upper edges of the compartments at a 45-deg. angle, using a saw to cut them. Then bring the bevels to a perfect 45-deg. angle by troweling on a mixture of ground cork and mastic, using a template as in Fig 5.

The metal lining is next. Either stainless steel or aluminum is used. A medium-gauge aluminum will prove very satisfactory. Before the metal is cut to shape, paper patterns should be fitted against the cork to determine the exact dimensions so the joints will be a perfect fit. This is necessary since the joints are not soldered, but depend on the mastic to hold the lining in place. The upper edges of the metal should overlap the bevels about 1 in. After the lining has been applied, using mastic to bond it to the cork, a Bakelite edging is cemented and screwed over the bevels. Again, paper patterns should be cut and tried to assure a perfect fit. After completing the compartments, bevel the insulation of the lids to fit the beveled surfaces of the compartments and apply metal and Bakelite as for the compartments. When preparing the lids it's a good idea to try them on the compartments frequently as the work progresses to compensate for any error that may have been made when beveling the compartments. A refrigerator cover-seal gasket of rubber, upper right-hand detail of Fig. 2, is screwed to the frame members before the Bakelite is attached. After the lids have been fitted, the hinges and handles are screwed in place. Chromium-plated hardware is used and the hinges should be attached firmly to the frame members and lids. A refrigerator dial thermometer, flush mounted, connects to the storage compartment. Any holes that are drilled are sealed with cork and mastic.

A $\frac{1}{2}$ -hp. condensing unit is used for a



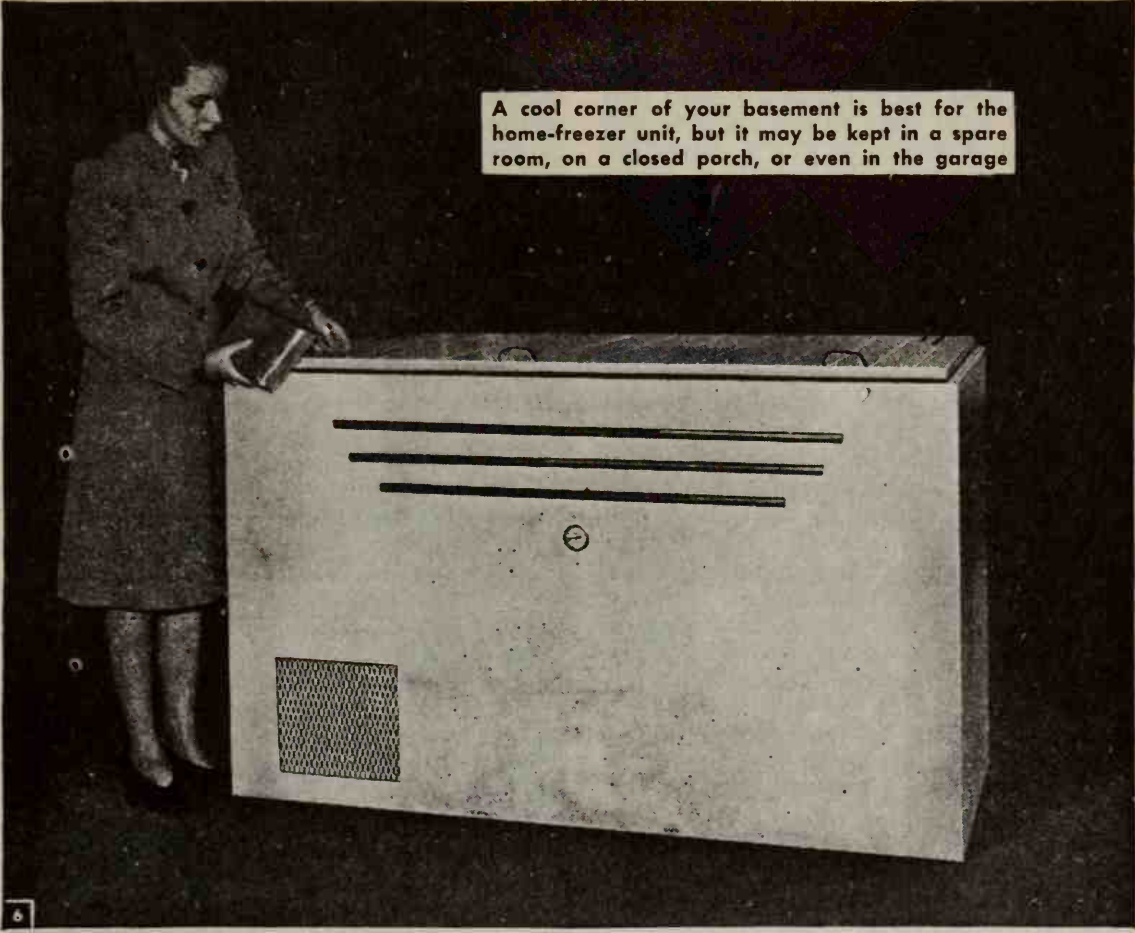
Troweling the asphaltic mastic that forms a bonding medium between the cork and plywood



Here the final coating which forms a seal between the sheet metal and the cork is applied



A template must be used to gauge the correct bevel between the sides and lid of the unit



A cool corner of your basement is best for the home-freezer unit, but it may be kept in a spare room, on a closed porch, or even in the garage

cabinet of this size, although smaller units can be used if the size of the compartments is reduced proportionately. The so-called "open" type consists of a compressor, condenser, receiver, motor and fan, the compressor being driven by a V-belt. Hermetic units have the motor connected directly to the compressor and a separate motor is used to drive the fan. If a rebuilt unit is used, be sure that the compressor valves are not leaking, as this will affect the operating efficiency considerably. Freon 12 is the refrigerant gas commonly used. Other required parts for the refrigeration system are a dehydrator, sight glass, two shutoff valves, two tees, two thermostatic expansion valves and a check valve, or a two-temperature valve if available. Flare fittings are used throughout. About 100 ft. of $\frac{3}{8}$ -in. and 8 to 10 ft. of $\frac{1}{4}$ -in. dehydrated copper tubing, as used for refrigeration work, are required. For this particular unit all parts are for $\frac{1}{4}$ -in. connections except one tee, which is $\frac{3}{8}$ in., as is the check valve. The expansion valves, which have $\frac{1}{4}$ -in. inlets and $\frac{3}{8}$ -in. outlets, must be for a $\frac{1}{3}$ -hp. unit. A pneumatic temperature-control unit of suitable range is used to start and stop the motor. The connections to be made are shown in color.

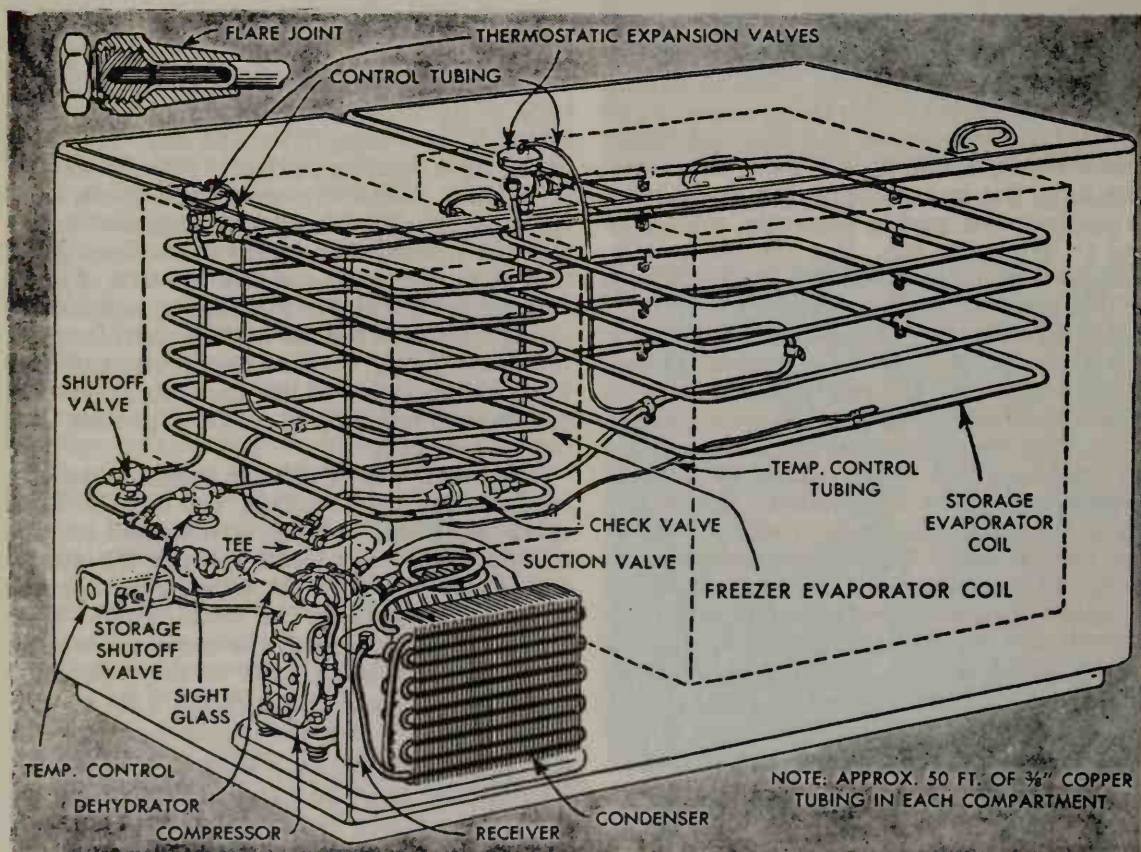
Fig. 7 shows the complete refrigeration system installed. When making a flare joint, upper left-hand detail, the end of the tube is compressed against the seat of the fitting by screwing down the nut. The end of the tube must be perfectly round and cut off square. Carefully remove all burrs and chips of metal and keep all filings and chips out of the tube to prevent them from getting into the refrigeration system. Form the end of the tube with a flaring tool, making certain that the flare is the right length. If it is too short, it will not seat fully and the tube will pull out of the flare nut, while if the flare is too long it will not permit the nut to seat properly.

The manner in which the connections are made is indicated in Figs. 7, 9 and 10. The condensing unit, which is mounted on an integral base, is placed toward the front end of the compartment with the condenser against the grille in the front panel. The outlet connection from the receiver, which is for $\frac{1}{4}$ -in. tubing, runs to the dehydrator, the sight glass and through a tee to the shutoff valves and the expansion valves. All these are $\frac{1}{4}$ -in. fittings. All bends should have as large a radius as possible so the tubing is not compressed. The shutoff valves are made so they can be screwed to

the top of the compartment. The evaporator coils, which are the coils inside the compartments, are $\frac{3}{8}$ -in. tubing. They connect to the outlets of the expansion valves and are secured with clips to the walls of the metal lining as shown in Fig. 9. About 50 ft. of tubing is required for each compartment. From the storage compartment, the line runs to a check valve and then to a $\frac{3}{8}$ -in. tee. The return from the freezer compartment goes directly to the same fitting from which a common return goes to the suction valve of the compressor, Fig. 7. Bending tools are used when making the evaporator coils, which should be formed before they are screwed to the metal lining. Two holes are drilled in each compartment, one for the $\frac{1}{4}$ -in. inlet tubing and the other for the $\frac{3}{8}$ -in. outlet. In the case of the storage compartment, the outlet hole should be large enough to accommodate the capillary or temperature-control tubing which connects to the temperature control. The holes are hermetically sealed with the mastic-and-cork mixture. The bulb for the control is clamped to the evaporator coil, as indicated in Fig. 7. The control tubing for the expansion valves is clamped to the coils at a point about 2 ft. from where the coil leaves the compartment. The exact spot will have to be determined by experiment. After the system is in operation, there should be no frost on the suction-side

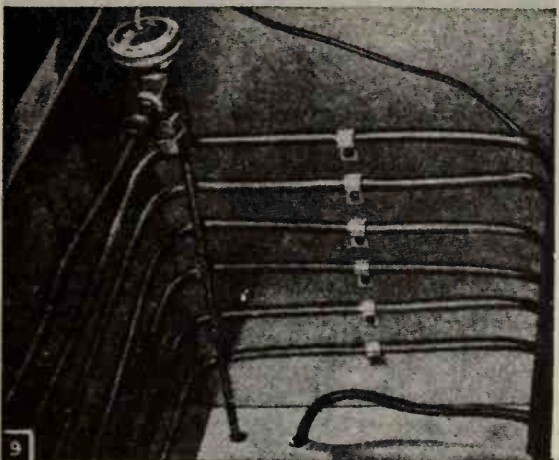
tubing outside the compartments. If there is, the control-tubing clamp should be moved farther back from the outlet. If a satisfactory adjustment does not result, the setting of the expansion valve will have to be changed. However, this is set at the factory and should be reset by a refrigeration serviceman. The manner of adjustment varies with the different makes of valves. The completed unit is then painted and finished with metal trim, Fig. 6.

If you are unfamiliar with refrigeration work, it's best to have a serviceman connect the condensing unit to the coils and put the system in operation. This includes purging the tubing of air, checking the suction and discharge pressures, and testing for refrigerant leakage. This work can be done for a nominal sum. It is necessary that there be no air in the system because air is much less compressible than Freon and, for that reason, may ruin the valves of the compressor. The simplest way to purge the coils of air is as follows: after the connections have been made and tightened, a standard refrigeration suction gauge is installed in the port provided on the suction valve, which is then opened slightly; open the receiver outlet valve and both shutoff valves to admit refrigerant to the evaporator coils. When the gauge pressure rises to about 20 lbs., close the suction valve on the compressor and the valve on the re-

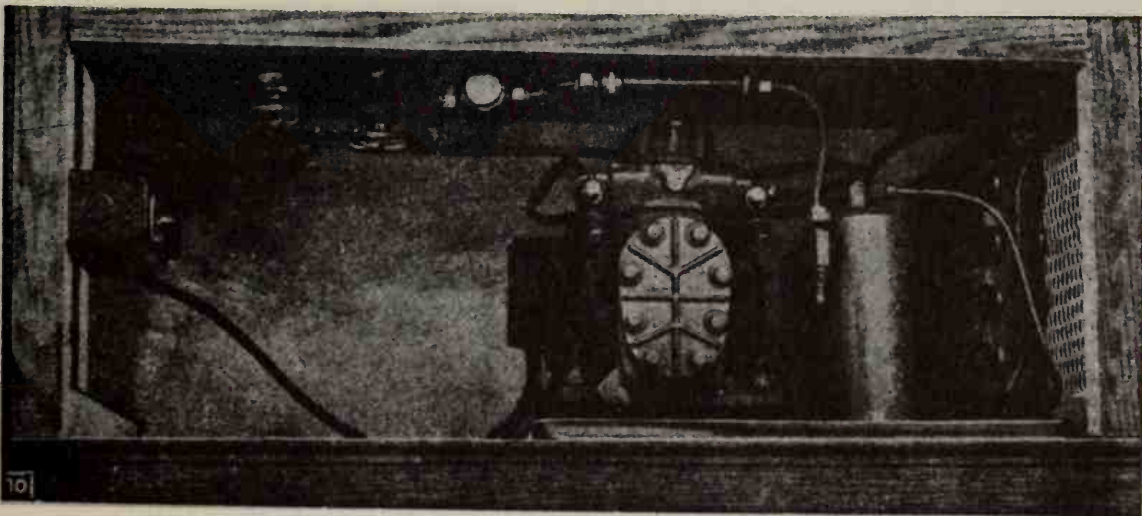




Temperature readings are being taken with a thermocouple during the initial test of this home-freezer unit



Above: The evaporator coil is attached to the sidewalls of the freezer compartment with small metal clips. Below: Arrangement of the condensing unit, valves, sight glass and dehydrator is shown here



ceiver outlet. The coils now contain a mixture of refrigerant and air; loosen the flare nut that connects the tubing to the suction valve to purge the tubing of this mixture, then tighten the nut again. It will be necessary to repeat the operation about three times. Care must be taken when purging the lines. Not following the proper sequence might result in excessive loss of refrigerant or cause damage to the condensing unit when it is put into operation.

After the system has been purged, all valves are opened and the motor is connected to a power source to put it into operation. All valves should be opened fully, otherwise damage may result. The temperature of the storage compartment is regulated by the temperature control. When it is not desired to use the freezer compartment, close the shutoff valve to put it out of service.

Since the home-freezer unit is not opened as frequently as a refrigerator, it will not require defrosting as often. However, when the coils are heavily frosted, the frost should be removed with a wire brush to keep the unit operating at its highest efficiency. For easy access, food should be kept in wire baskets, or dividers should be used.

A few of the common troubles experienced in the operation of refrigeration systems follow, together with the cause and correction. (When working around a condensing unit, always disconnect the motor as the operation is automatic and the unit may start at any time.) If the compressor runs in short cycles, it may be due to the fact that the suction and discharge valves are partially closed when they should be wide open and in the back-seated position. Obstructions over the grilles may cause insufficient ventilation. Periodically the grilles should be cleaned and the condenser gone over with a brush to be sure that there are no obstructions. A low charge of

refrigerant will also cause the unit to run too frequently; if bubbles show in the sight glass or the liquid appears cloudy, this indicates the need of additional refrigerant. It should be noted that when food is put into the freezing compartment, there will be a heavy load placed on the refrigeration system and it will run more frequently than when in normal operation.

If the compressor knocks, it may be due to air in the system which should be purged, or in open models it may be due to a lack of oil in the crankcase. If the latter is true, a refrigeration serviceman should add the proper kind of oil. Frost on the compressor head is an indication that the suction pressure is too high and this is corrected by adjusting the control tubing on the expansion valves. As a general rule, there should be no frost on the lines after they leave the freezing and storage compartments. Compressors that are driven through a V-belt should have the drive tested for tension and alignment if belt slippage is suspected. When lubricating a unit, remember that oil deteriorates V-

belts and avoid dropping any on the belts.

Moisture is seldom found in a properly maintained refrigeration system, and no system will function correctly if there is moisture in it because the water will freeze at the expansion valve and then be blown free by accumulated refrigerant pressure, resulting in erratic suction pressure. If replacing the dehydrator fails to correct this condition, the expansion valve may have to be removed and dried out as well. In either case, it's best to have a serviceman do the work since the refrigerant must be exhausted from the evaporator coils and pumped into the receiver and condenser.

Should it become necessary to take the unit out of service, or should there be an extended power failure, dry ice can be put in the storage compartment to hold the temperature, or the food can be moved to a locker plant. However, care must be taken when using dry ice as its temperature is 110 deg. below zero and it may reduce the temperature in the box too far. The ice should not be handled with bare hands as this may result in a "burn."

FRICION SAWING

METAL UP TO 14 GAUGE IS CUT AS FAST AS HAND CAN PUSH THE WORK

TEN times faster than hacksawing—that's what you can expect when you switch to friction cutting on the bandsaw. Three feet per minute in $\frac{1}{8}$ -in. steel is not a "souped-up" test figure obtained under ideal conditions, but exactly what you can expect with your 12 to 16-in. woodworking bandsaw.

Simply increase the saw speed to about 2800 f.p.m. and then change to a standard metal-cutting blade and you are all set to friction-saw sheet metal and angle iron up to about $\frac{1}{8}$ in. thick. Friction sawing works by heating the metal red hot at the point of contact so that the saw teeth can strip it away. If you want to cut stock over $\frac{1}{8}$ in., you will need more speed. For average work, the single speed setup of about 2800 to 3000 f.p.m. has the advantage of simplicity and is excellent for either wood or metal with nothing more than a change of blade. An ideal setup is a step-pulley drive, one step giving a 3000-f.p.m. speed for wood

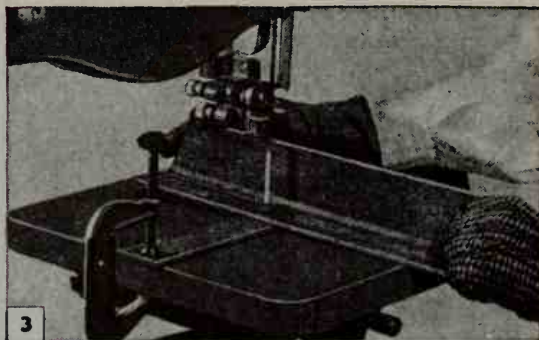
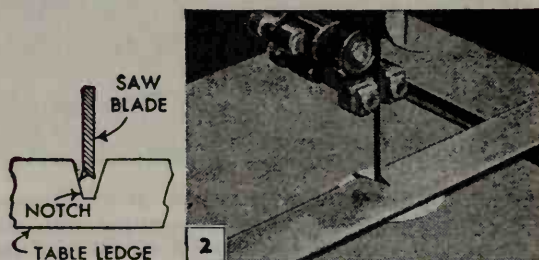
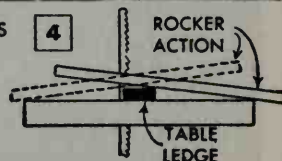


TABLE LEDGE PREVENTS BURRED EDGE FROM CATCHING IN TABLE INSERT . . . ALSO PERMITS ROCKING ON HEAVY CUTS





GLUE TIRES ON FOR SPEEDS OVER 4000 F.P.M.

sawing and sheet-metal cutting, and the second step a speed of about 4000 f.p.m. for friction-sawing metal up to about $\frac{3}{16}$ in. thick. The table, Fig. 6, will help you select a suitable pulley drive. Table, Fig. 8, shows thickness limitations and other factors.

Cutting technique is standard except that for work over $\frac{1}{8}$ in. thick use a strip of metal clamped across the saw table, as in Figs. 2, 3 and 4. Prime purpose of this is to prevent the burr, which forms on the underside of work, from catching in the slot in the table insert. A similar fixture is used for cutoff work, Fig. 7. Regarding the speed increase, any fair quality bandsaw will go up to about 3800 f.p.m. quite smoothly. At about 4000, the wheels will probably throw the tires; cement them to the wheel rims as in Fig. 5. It's also a good idea to drive with a $\frac{1}{2}$ -hp. motor. Be sure the V-belt is fairly tight and that the machine stands firmly on the floor or bench. If the blade should break, stop the machine as soon as possible.

Blade life is very good, averaging 28 to 30 hours, or an equivalent of about 5000 linear feet in 1/8-in. steel. The blade wears out by blunting of the teeth until the blunted area in contact with the work becomes too great for cutting clearance. The blade does not lose its temper because the red-hot cutting contact is only momentary—any one tooth has a cooling cycle several hundred times longer than its contact cycle. Blade life depends to a certain extent on the uniformity of feeding the work to the blade. Burring is the worst fault. It is negligible in thin stock, Fig. 1, but increases rapidly with work thickness. The cut itself is fairly smooth with but slight "washboarding." It is advisable to wear gloves—small work gets uncomfortably hot and all cuts have a raw, burred edge that can inflict a painful injury if you risk handling the work with bare hands.

6 BANDSAW SPEEDS* IN FEET PER MINUTE							
Motor Pulley	Dia. of Bandsaw Wheels	Machine Pulley Diameter					
		5"	5½"	6"	6½"	7"	8"
2¾"	10"	2418	2210	2028	1872	1742	1508
	12"	2883	2635	2418	2232	2077	1798
	14"	3441	3145	2886	2664	2479	2145
	15"	3627	3315	3042	2808	2613	2262
	16"	3906	3570	3276	3024	2814	2436
3"	10"	2652	2418	2210	2028	1898	1664
	12"	3162	2883	2635	2418	2263	1984
	14"	3774	3441	3145	2886	2701	2368
	15"	3938	3627	3315	3042	2847	2496
	16"	4284	3906	3570	3276	3066	2688
3½"	10"	3094	2808	2574	2340	2210	1924
	12"	3689	3348	3069	2790	2635	2294
	14"	4403	3996	3663	3330	3145	2738
	15"	4641	4212	3861	3510	3315	2886
	16"	4998	4536	4158	3780	3570	3108
4"	10"	3536	3224	2938	2730	2522	2210
	12"	4216	3844	3503	3255	3007	2635
	14"	5032	4588	4181	3885	3589	3145
	15"	5304	4836	4407	4095	3783	3315
	16"	5712	5208	4746	4410	4074	3570
4½"	10"	3978	3614	3302	3042	2834	2470
	12"	4743	4309	3937	3627	3379	2945
	14"	5661	5143	4699	4329	4033	3515
	15"	5967	5421	4953	4563	4251	3705
	16"	6426	5838	5334	4914	4578	3990
5"	10"	4420	4030	3692	3406	3146	2756
	12"	5270	4805	4402	4061	3751	3286
	14"	6290	5735	5254	4847	4477	3922
	15"	6630	6045	5538	5109	4719	4134
	16"	7140	6510	5964	5502	5082	4452

*With Standard 1725 R.P.M. Motor



THIS 1/8" X 1" ANGLE WAS CUT OFF IN 7 SECONDS

8 BLADE SELECTOR AND DATA						
Material Thickness*	Blade Speed	Min. Blade Width	Teeth Per Inch	Min. Cutting Radius	Hp. Req'd	Feed Pressure
Up to $\frac{3}{32}$ " or 13 Gauge	2800	$\frac{1}{4}$ "	18-24	$\frac{5}{8}$ "-1"	$\frac{1}{3}$	Light
$\frac{1}{8}$ " to $\frac{3}{16}$ "	3600	$\frac{1}{4}$ "	14-18	1"-1 $\frac{1}{2}$ "	$\frac{1}{3}$ or $\frac{1}{2}$	Mod.
$\frac{3}{16}$ " to $\frac{1}{4}$ "	4400	$\frac{3}{8}$ "	14	1 $\frac{1}{2}$ "-3"	$\frac{1}{2}$	Fairly Heavy

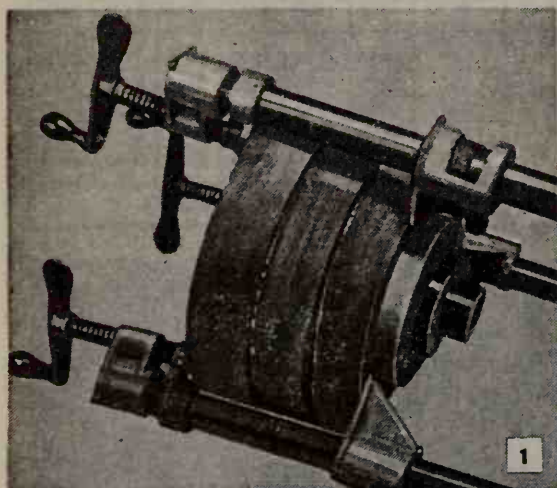


A tenon is formed around the edge of the bottom disk to fit a matching groove turned in the second piece



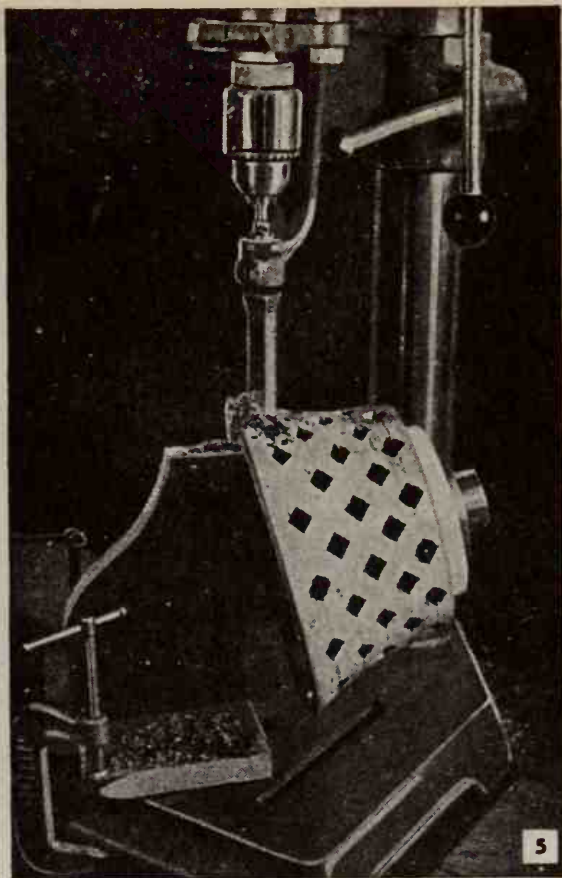
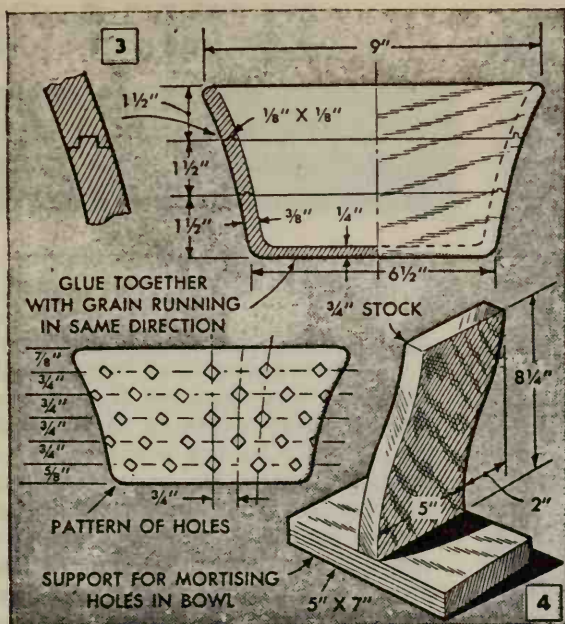
FRUIT BOWL

HOW DID YOU make it? That's the first question your craft friends will ask when they examine this unique fruit bowl. They'll see right away that it was first turned, but how the square holes were formed usually will keep them guessing. Oddly enough, the piercing of the bowl is actually the easiest part of the whole job for it's done merely with a mortising chisel in the drill press. The bowl itself is a typical turning job, being turned from either a solid block or three separate pieces glued and clamped together as shown in Figs. 1 and 3. Note in Fig. 1 that the bottom section of the built-up block is glued to a waste block for attaching a faceplate. The outside of the bowl is turned to final size and sanded smoothly at this time but, on the inside, the wall thickness is left about $\frac{1}{8}$ in. oversize. This is done to provide waste to take care of any chipping that occurs when piercing the bowl. Fig. 3 shows how the outside of the bowl is marked off to locate the points for piercing. A $\frac{1}{2}$ -in. mortising chisel is used, as well as a jig to support the bowl. This is made of wood as in Fig. 4 and is clamped to the drill-press table as shown in Fig. 5. Ease the chisel through the work slowly in making each hole to prevent excessive chipping. After the piercing is completed, the bowl is remounted in the lathe and the inside is turned down. This operation requires extreme care and the use of a very sharp, pointed tool. Finish by touching up the holes with a square file, sanding and giving the bowl a French polish of shellac and sweet oil while it is still mounted in the lathe.



Above, built-up assembly with faceplate attached is glued and clamped. Center of two disks is removed beforehand. Below, the inside is turned after piercing





In piercing the bowl, it is held on a wooden standard. Note that this is clamped to the base of the drill press at a 45-deg. angle. Ease the mortising chisel through the work and hold the bowl firmly when the chisel begins to break through. The faceplate is left in place so that the bowl can be replaced for final turning

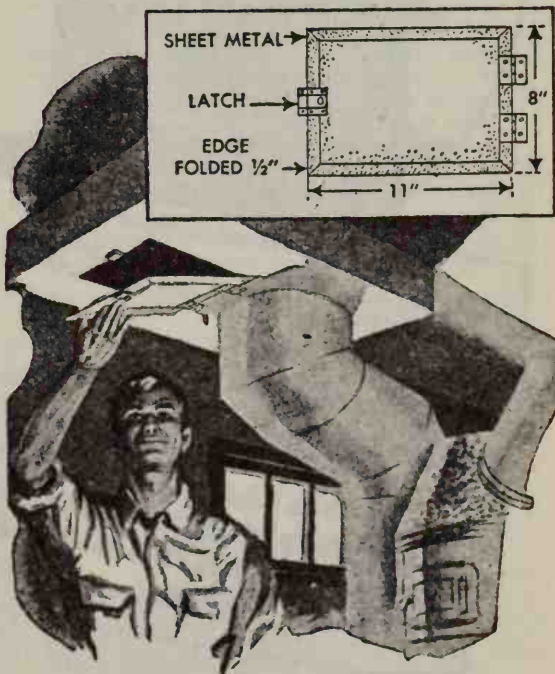
Fruit Jars Labeled with Crayons

To avoid the work of making labels to indicate the contents of fruit jars, simply write the name of the contents on the jar with a wax crayon. This must be done while the jar is still warm. Various colors of crayons may be used to further classify the jars.

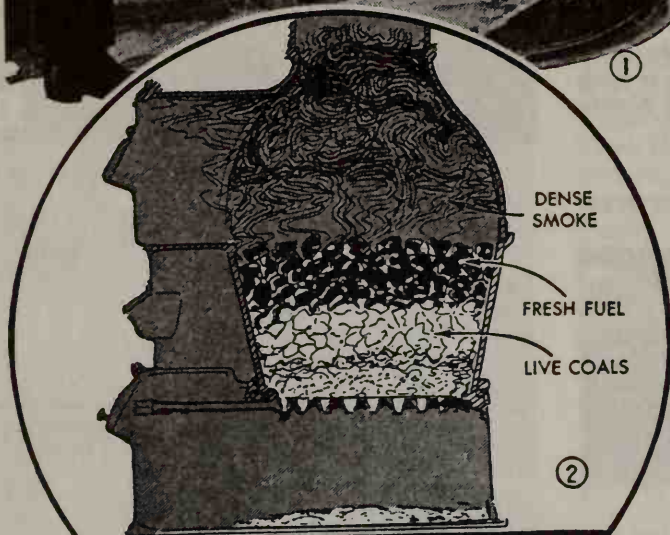


Clean-Cut Door in Cold-Air Duct Provides Easy Access

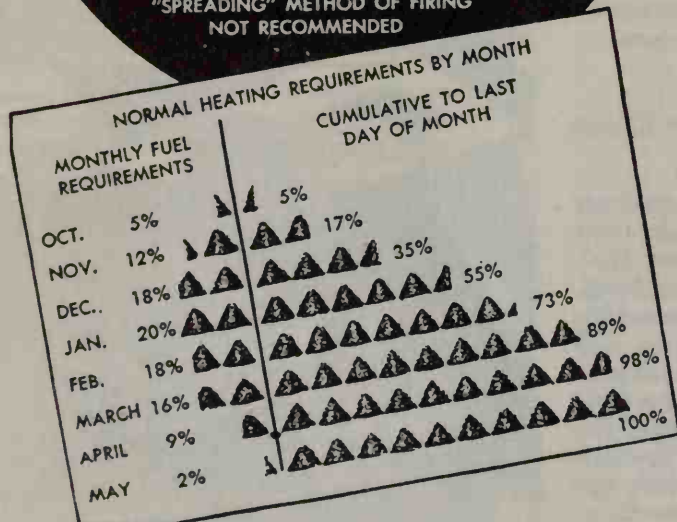
This small clean-out door in the cold-air return of your furnace will provide easy access when removing accumulated dirt. The opening in the duct should be 1/2-in. smaller all around than the dimensions given for the door so that the door will overlap the edges to provide a seal and prevent basement air from entering the duct and lessening the recirculating effect of the sealed return. Hinges for the door are soldered or bolted in place and a latch opposite the hinges keeps the door closed.



INSUFFICIENT HEAT



"SPREADING" METHOD OF FIRING
NOT RECOMMENDED



FURNACE

Getting at the causes of common
Helpful tips that make hand firing
your plant at peak efficiency

NO ONE would deliberately throw a shovel or two of coal outside every day, yet the equivalent of this waste is discharged into the air in the form of combustible gases by many home heating plants. A smoky fire consumes fuel but produces insufficient heat, which is one of the most common complaints of home owners. The causes of this trouble are many and varied, and are best found by the process of elimination—starting with the most likely cause, which is incorrect firing, and then proceeding with other causes until the trouble is found and corrected.

Keep the ash pit clean: It should always be nearly empty. Ashes banked up in the pit as indicated by A in Fig. 1, reduce air supply, increase the velocity of what air does reach the fire when the lower draft is open, and result in "live" and "dead" spots here and there over the fire bed. Ashes touching the grates at any point tend to concentrate the heat and warp or break the grates. It's best to clean the ash pit before shaking the grates. A thin, skimpy fire, B in Fig. 1, also Fig. 22, is wasteful of both heat and time as it requires more frequent attention. Fuel bed should be level with or slightly above the bottom of firing door.

Spreading method of firing causes slow "pickup": Spreading fresh fuel over the whole fire bed as in Fig. 2, "blankets" the fire, shuts off the heat, and results in the release of great quantities of valuable gases, which escape unburned up the chimney. In firing soft coal, a dense smoke is produced when a bed of live coals is covered with fresh fuel. Before ignition can take place over the whole fire bed the furnace and the house cool down. As a result, there is a tendency to force the fire with full draft, which speeds

OPERATION

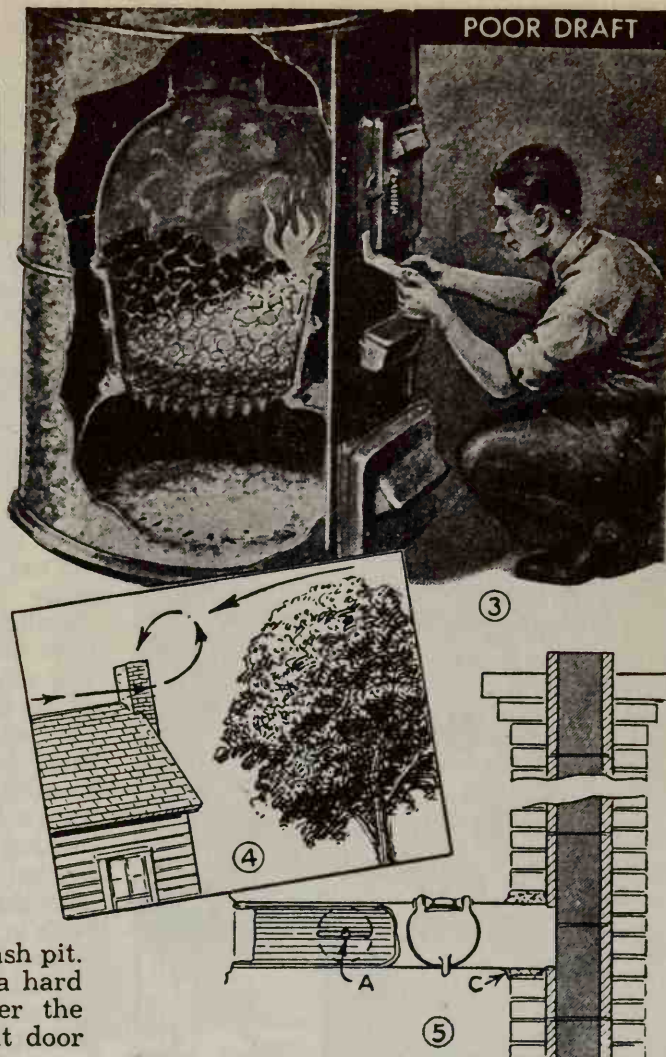
troubles in home heating plants. easier and enable you to operate and greatest economy

up the rate of ignition and makes the fire wasteful and difficult to control.

House cold in the morning: This condition can be due to many causes and to defects in the heating plant. The chart in Fig. 9 is the result of a study of reasons for the unsatisfactory operation of home heating plants. Banking the fire with ashes is one of the causes. Ash placed on live coal gradually stops the burning. The heat is absorbed by the ash which reaches the fusion point and forms a clinker. The latter slows down flow of air through the fuel bed. By morning the fire will be practically out. The remedy is to be sure the equipment is in good condition and then fire by approved methods, leaving a trifle more draft on the fire over night.

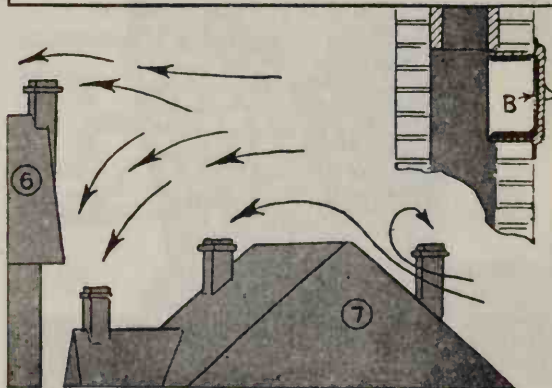
Fire picks up slowly or is sluggish: This condition usually is caused by a poor draft. Check the ash pit. Probe the fire bed for clinkers or a hard crust, which sometimes forms over the burned-out ash. Open the cleanout door and examine the interior of the furnace with a flashlight for heavy deposits of soot and fly ash which sometimes collect in sufficient amounts to hamper the draft. Be sure the turn-damper, A in Fig. 5, is open. If correcting these conditions fails to remedy the trouble, then use a strip of tin as a feeler gauge and "feel" along the edges of all doors, as in Fig. 3. Check fire doors, clean-outs on furnace and at the bottom of chimney as at B in Fig. 5. If you can insert the "feeler" and move it a distance of more than 3 or 4 in. along any of these openings, you have an air leak that may interfere with the draft. This can be corrected by filing the edge of the door until it fits.

Chimney or surrounding structures reduce draft: A large tree near the house, Fig. 4, with its top higher than the chimney, can be the cause of impaired draft, as it creates an eddy air current, and sometimes a strong down-draft when the wind is blowing. Likewise, adjacent buildings higher than the chimney will cause the same condition as indicated in Fig. 6. If the top of the chimney is lower than the roof ridge you are almost sure to have trouble.



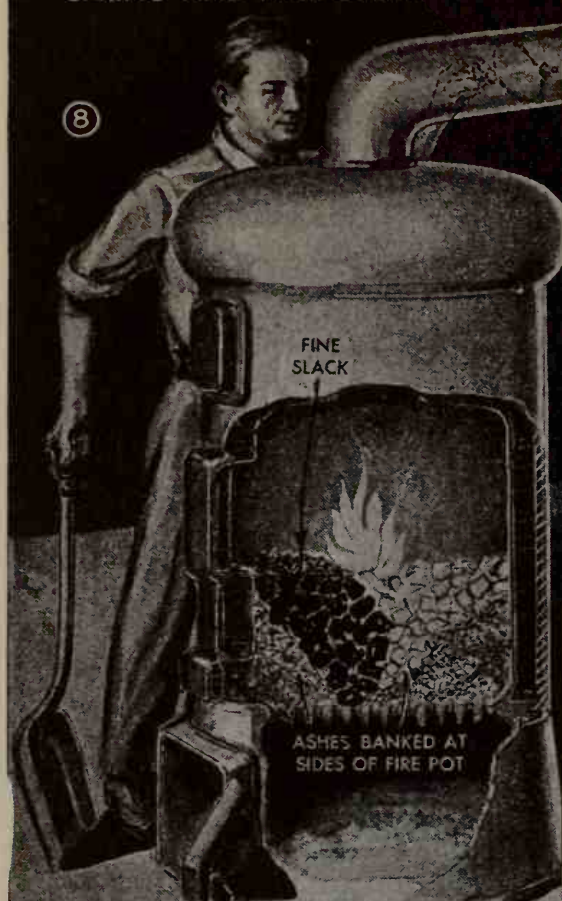
HOW TO FIND YOUR TROUBLE

When your heating plant operates unsatisfactorily there are usually many possible causes for one effect. Generally the causes of insufficient heat, poor draft, excessive consumption of fuel, clinker formation, etc., are easy to discover and remedy if one takes the time to apply a simple process of elimination. As an example, the cause of poor draft may not lie in the heating plant at all. In certain cases it has been found that simply opening the basement door or a window has completely cured the trouble. In these instances the remedy was simply more air circulation in the basement. Often, cures for other troubles are just as simple



SPRING AND FALL OPERATION

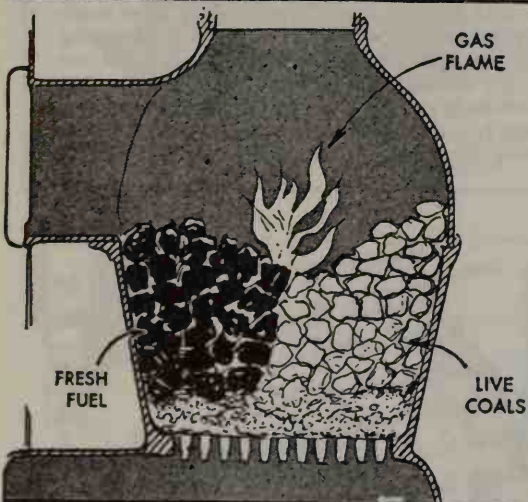
⑧



FAULTY
EQUIPMENT
67%

IMPROPER
FIRING, 23%

IMPROPER SIZE COAL, 5½%
OTHER CAUSES, 4½%



⑩

SIDE-BANKING FRESH FUEL BETTER THAN
SPREADING (BITUMINOUS COAL ONLY)

Air striking the roof is deflected as in Fig. 7 and the resulting eddy currents create down-drafts in the chimney. In severe winter weather, the cold air in the upper part of the flue of the outside chimney may act as a baffle, checking the free movement of gases from the chimney. The procedure in correcting any of these faults depends, of course, on the conditions. If there is no outside defect, then it's well to examine the chimney itself. Any large cracks in the mortar or at the smokepipe opening, C of Fig. 5, will act as check dampers. Finally, remember that nests of chimney swallows, or swifts, sometimes block the flue. Also, a basement or cellar that is shut up tightly is nearly always "air-locked." Records show that sometimes opening the basement door or a window slightly will cure a stubborn case of poor draft.

Fuel bed for mild weather: The entire grate area is not needed during mild weather so only the center is kept clear with the poker. The grates are not shaken and ash is allowed to bank up on the sides of the fire pot as in Fig. 8. This cuts down the heat output of the fire bed and, at the same time makes it easy to control. Due to adding smaller amounts of fresh fuel, such a fire will burn low in a shorter time, making it advisable to put on full draft a few minutes before firing so there will be a bright coke bed to receive the fresh fuel. Note in Fig. 8 that the live coals are pushed to one side before firing the fresh charge of coal. To hold the fire longer, cover the nut coal with a shovelful of fine slack as shown. This can be made by breaking up larger pieces of coal to the pea size. Be sure, before leaving the fire, that a gas flame has started, otherwise it will smolder. Also, there is the likelihood that the column of gases from a long-smoldering coal fire will ignite suddenly and cause a serious explosion. See that there is a fairly strong draft just after firing, especially on windless days. Once the gas is ignited, the drafts usually can be closed and the fire checked to conserve the heat.

"Side-banking" when firing soft coal: In any weather, side-banking the fresh fuel as in Fig. 10, is a great improvement over the spreading method in that it prevents rapid escape of gases which takes place when fresh fuel is spread over a hot bed of coals. Grates are shaken lightly to remove surplus ash, live coals are worked to the back or side of the fire pot, and fresh coal is placed in the pit or depression thus formed. The charge is not heaped but live coals and fresh fuel are sloped to the center as indicated. By this method ignition of the fresh fuel takes place slowly and the gases are burned as they are driven off. It is essential to remove all live coals from

the bottom of the depression where the fresh fuel is placed, as otherwise ignition will take place from the bottom as well as the side and the value of the practice will be lost.

Don't burn garbage in furnace:

Garbage thrown on a hot fire, Fig. 11, will immediately cut the heat output by as much as 50 percent, and it will take the fire some time to recover even a part of the loss. Even a small quantity of garbage or other foreign material is almost sure to form a hard clinker when thrown on a hot fire. In addition to the heat loss and consequent waste of fuel, a large clinker is often very difficult to remove. Sometimes the furnace and grates are damaged in the process. A clinker forming in the hot fire also tends to blanket the heat and, in effect, force it downward, sometimes heating grates to the danger point.

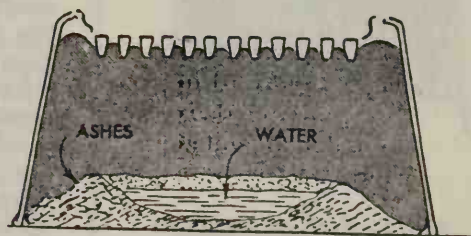
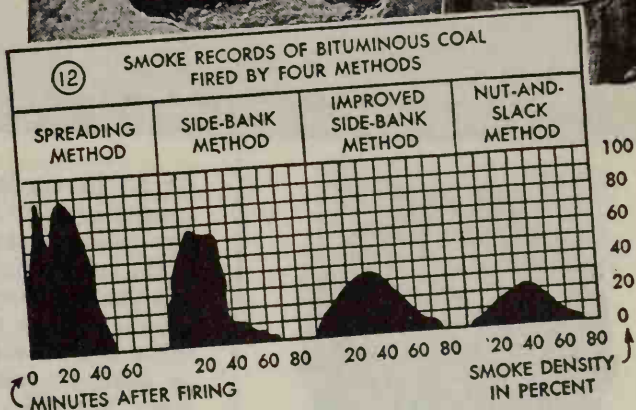
Avoid closing drafts on a high fire:

Closing the drafts suddenly on a very hot fire often causes a hard clinker to form as the furnace surfaces cannot absorb the excessive heat that is suddenly bottled up and reflected back into the fire bed which quickly fuses or makes clinkers under the excessively high temperature. It's better to close the drafts on a hot fire by stages, leaving the lower draft open just the width of a match stick, and opening the check damper only part way until the burning rate slows down to more nearly normal.

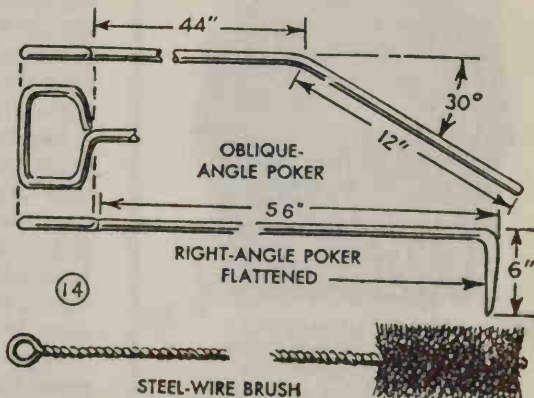
Water in ash pit aids combustion: With certain grades of fuel, clinkering can be prevented and combustion aided considerably by leaving a small quantity of ash in the ash pit and keeping this moist by adding water occasionally, as in Fig. 13. In this connection it's also a good idea to wet or "temper" the fuel. This should not be done immediately before firing but the fuel should be sprayed at regular intervals with water so that the coal particles have a chance to absorb moisture.

Tools needed in hand firing: In firing a furnace by any of the recommended methods you will need two pokers and the wire cleanout brush shown in Fig. 14. Of the two pokers the oblique-angled type is the more important as it is efficient in probing the fire bed and in working live coals to the side of the fire pot. The wire flue brush is essential for loosening soot and fly ash.

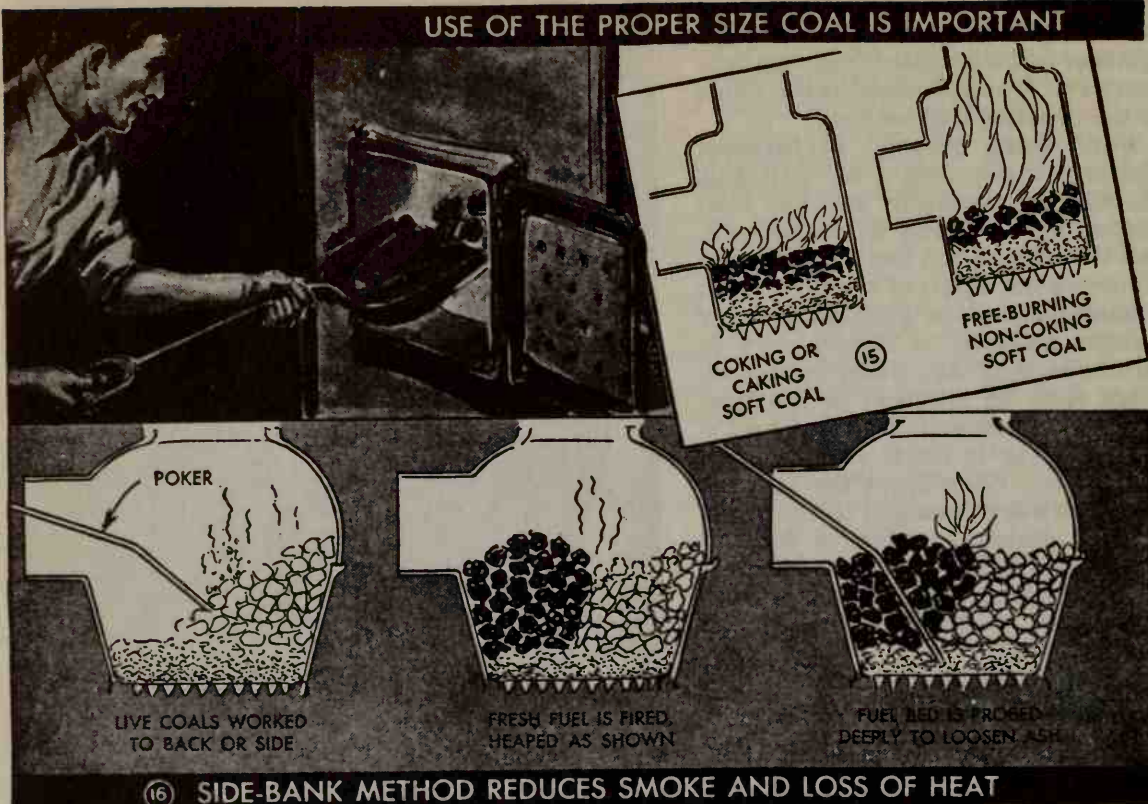
Use the right size coal: Usually this is more important when burning the smokeless fuels, such as hard coal and coke, but it also applies in the extremes to soft fuels.



13 WATER IN ASHPIT AIDS BURNING



USE OF THE PROPER SIZE COAL IS IMPORTANT



16 SIDE-BANK METHOD REDUCES SMOKE AND LOSS OF HEAT



17 LARGE LUMP FUEL RESULTS IN EXCESSIVE HEAT LOSS



18 SMALLER LUMP SIZES ADMIT LESS AIR, BURN MORE EFFICIENTLY; APPLIES TO ANTHRACITE COAL AND COKE

As an example, fine soft-coal slack and forkings cannot usually be burned successfully in the average home furnace without a forced draft. When firing soft coals by any of the three approved methods the sizes generally referred to as nut, stove and range, usually will be found satisfactory. Most soft fuels are divided into two types known as coking or caking coals and the free-burning non-coking type, Fig. 15. These terms refer to the burning characteristics rather than to the lump size. Also, the two are sometimes referred to as short and long-blaze coals. In the hard fuels, particularly coke, the large lumps bulk up loosely admitting the passage of excess air through the fire bed. This condition moves the heat so rapidly that only a part of it is absorbed and transferred by the exposed surfaces of the furnace, Fig. 17. Loss of heat up the chimney is sometimes excessive. The smaller lump sizes, Fig. 18, admit less air, burn more efficiently in a deep fire, Fig. 23, and produce more useable heat. Where the natural draft is very strong the burning rate can be controlled better if a small amount of fine lump fuel is placed on top of the regular charge.

Improved side-bank method: With two exceptions in procedure, this is the same as the ordinary side-bank method. The sequence of the firing operations is detailed in Fig. 16. By this method the grates are rarely, if ever, shaken. The fresh fuel is heaped slightly as indicated and as the final step the fuel bed is deeply probed over the whole grate area to loosen and sift out the fine ash.

Nut-and-slack method: This method of firing is essentially the same as the side-banking procedure except that two sizes of coal are used. Fig. 21 de-

19 KEEP THE BOILER OR FURNACE CLEAN

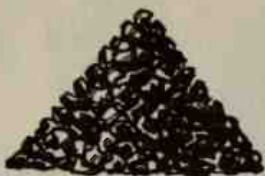
HEAT LOSS FROM
FLY ASH AND SOOT
IN TERMS OF COAL



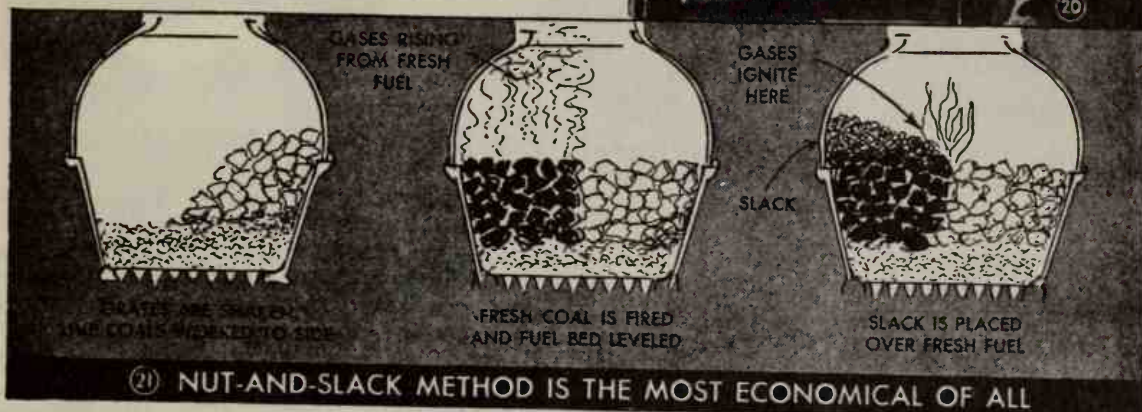
$\frac{1}{32}$ " DEPOSIT
9.5% LOSS
190 LBS.
OF COAL



$\frac{1}{16}$ " DEPOSIT
26% LOSS
250 LBS.
OF COAL



$\frac{1}{8}$ " DEPOSIT
45% LOSS
906 LBS. IN EACH
TON OF COAL



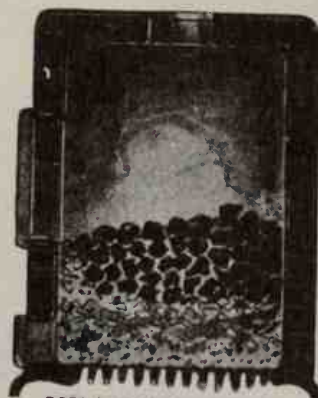
21 NUT-AND-SLACK METHOD IS THE MOST ECONOMICAL OF ALL

tails the steps. Grates are shaken gently, with only a few long strokes as in Fig. 25. Coals and coke remaining from the previous charge are worked to the side of the fire pot. After firing the fresh charge, the fuel bed is leveled and slack is placed over the fresh fuel. Slack from the same kind of coal should be used if possible. Following the sequence of this method requires somewhat more coal for each fresh charge but actually the overall consumption of fuel is less than that when using other methods because of the greater heat output from a given amount of coal, assuming that the heating plant is in good condition. In addition, the latter method as described produces less smoke than any other as you can see from the smoke chart, Fig. 12. It's important to note that success with any of the three approved methods depends on careful attention to details.

Heat loss from fly ash and soot: Fig. 19 illustrates this loss graphically. One of the essentials to satisfactory operation is that the furnace and flue be kept clean, Fig. 20. On some of the later type hot-water and steam plants, passageways in the furnace can often be cleaned more efficiently by compressed air. Periodically scrubbing the radiator dome and the upper part of the fire pot with a wire flue brush usually will suffice for the average warm-air plant. Three other methods of ridding the furnace of soot as approved by the U. S. Bureau of Mines and the Engineering College, University of Illinois, are shown in Figs. 26, 27 and 28. Common granulated rock salt placed on a bright fire at regular intervals is quite effective. The methods shown in Figs. 27 and 28 also are effective in cleaning the flue but it should be remembered that on wood-shingled buildings there is some danger of a roof fire so it's



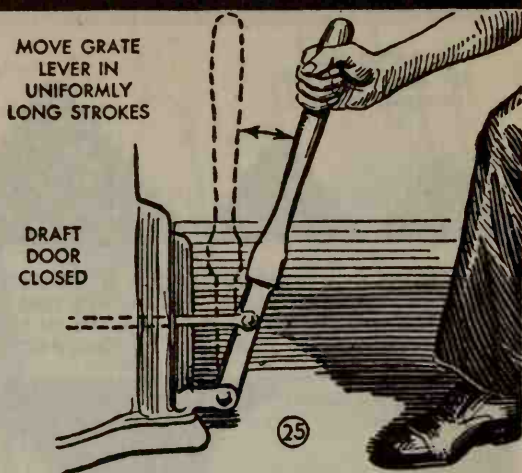
22 SHALLOW FIRE WASTES
FUEL AND HEAT



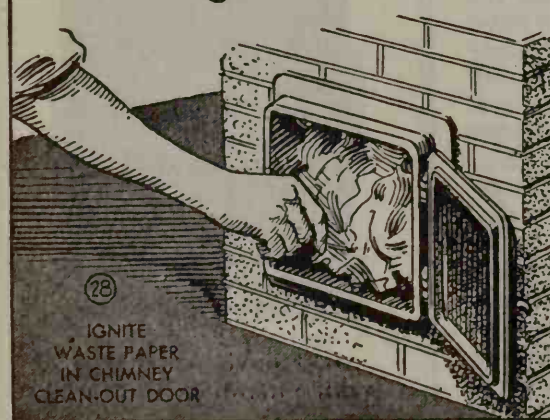
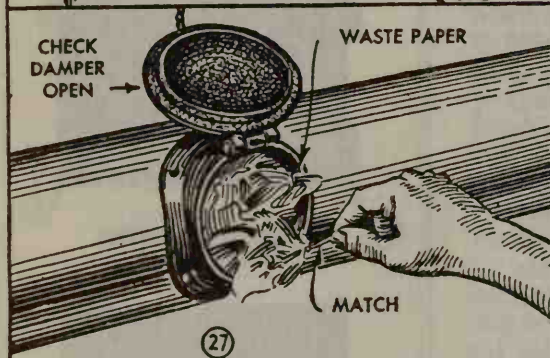
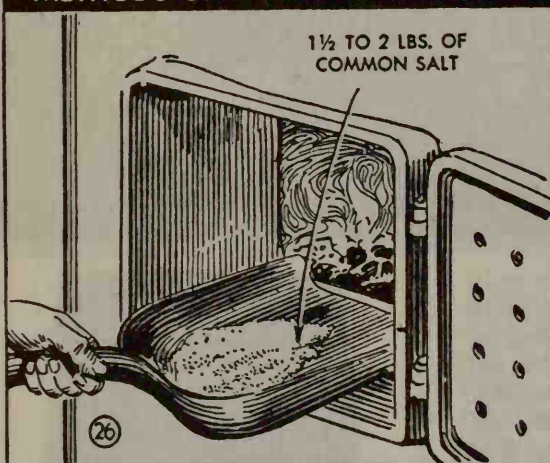
23 DEEP FIRE BURNS SLOWLY,
CONSERVES HEAT AND COAL.
APPLIES TO HARD AND SOFT FUELS



ALWAYS SHAKE GRATES GENTLY



METHODS OF CLEANING OUT SOOT

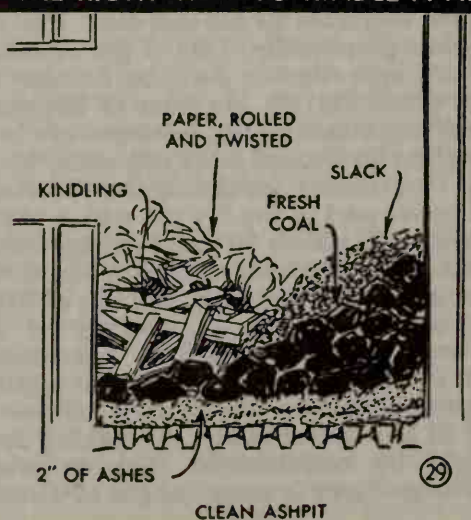


a good idea to burn out the flue only on damp or rainy days when the roof is wet. It should never be done in a chimney in poor condition or where the soot accumulation is unusually heavy. Clean out the bulk of the soot by other methods, such as dragging a chain up and down in the flue.

Over-draft damper: When burning soft coal the use of the over-draft damper, Fig. 24, in the fire door is important as gases evolved from the fresh fuel will not ignite in the furnace unless mixed with air. Just how much the over-draft should be opened depends somewhat on the fuel and the peculiarities of the individual furnace.

Kindling the fire: Ordinarily, paper is first placed in the furnace, the kindling next, and finally a small quantity of coal. A better method reverses this procedure as in Fig. 29. First, ash is worked through the grates until only about a 2-in. layer remains. Then the coal is placed as shown, with slack on top, leaving a depression at the front near the fire door. Into this is placed the kindling with rolled and twisted waste paper on top, which is lighted.

THE RIGHT WAY TO KINDLE A FIRE



FURNITURE

Includes drop-leaf table for combination living-dining room and sectional wall ensemble with versatile units



DESIGNED as companion pieces to harmonize with dining and living-room furniture of almost any style, these smart occasional pieces can be used to augment other pieces you already have or used by themselves in any particular arrangement you desire. The drop-leaf table pictured above is designed especially for a dining alcove where limited space does not permit room for even a small dinette set. Such is the case in the latest trend toward eliminating a separate dining room in favor of a combination living-dining room. This table is also ideal for the one-room or one-and-a-half-room-apartment dwellers. This piece adequately fills the requirement for a table that takes little space against the wall when not in use, and yet has big-table capacity when needed. To seat four persons comfortably, the leaves of the table are raised to a horizontal position and the whole top is rotated 90 deg. on a center pivot. In this position, the base of the table supports the drop leaves as



1 TABLE OPEN



2 TABLE FULLY EXTENDED



shown in Fig. 1. Retractable brackets in each end of the table pull out to support the leaves when the table is fully extended. A lazy-tong mechanism, taking the place of the usual extension slide, extends to permit insertion of two extra leaves, Fig. 2, providing a top surface 40 x 74 in. When the table is fully extended, you can accommodate six to eight dinner guests. You can either make your own dining chairs for the table or purchase suitable unfinished ones, to which you can apply a finish to match the table. In selecting the type of dining chairs you want, it is suggested that one which is not too bulky be chosen to stay in keeping with the compact table. Actual construction of the table, detailed in Figs. 12, 13 and 14, will be explained step by step later in the article.

The pieces of the functional wall ensemble pictured above are coordinated in size to fit together in a number of separate sectional arrangements in addition to the complete grouping shown. The arrangement pictured above is ideal for a rectangular-shaped room. The window unit can be shifted so that it is positioned correctly in front of the window. Here are other ar-

rangements. For the first example, the secretary, which is pictured in use at the bottom of the opposite page, may be combined with an open-end bookcase at each side. Likewise, the three-shelf unit, with doors at the bottom, may be grouped in the same way. An attractive corner grouping is had by flanking the corner bookcase with end bookcases. Still another arrangement is to place the window unit between two end bookcases. These are but a few of the attractive arrangements that are possible with these sectional pieces. If desired, any one of the three basic units, namely, the secretary, three-drawer chest and two-door chest, may be used individually.

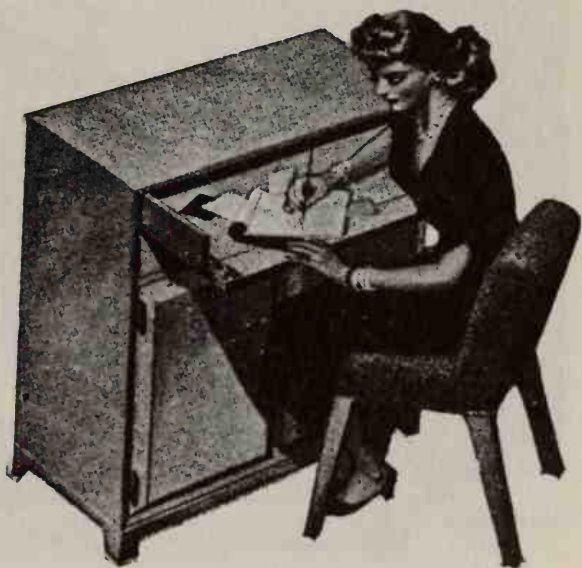
The secretary features a pull-out writing shelf which looks like a drawer when closed. This piece, in the closed position, is shown second from the left. The "drawer" front is hinged with special fixtures and lets down to become part of the writing surface, as illustrated at the right on the facing page. The secretary, like the other pieces, is made primarily from plywood, with solid stock being used for the drawers, base and edging. The edging is used here to give a

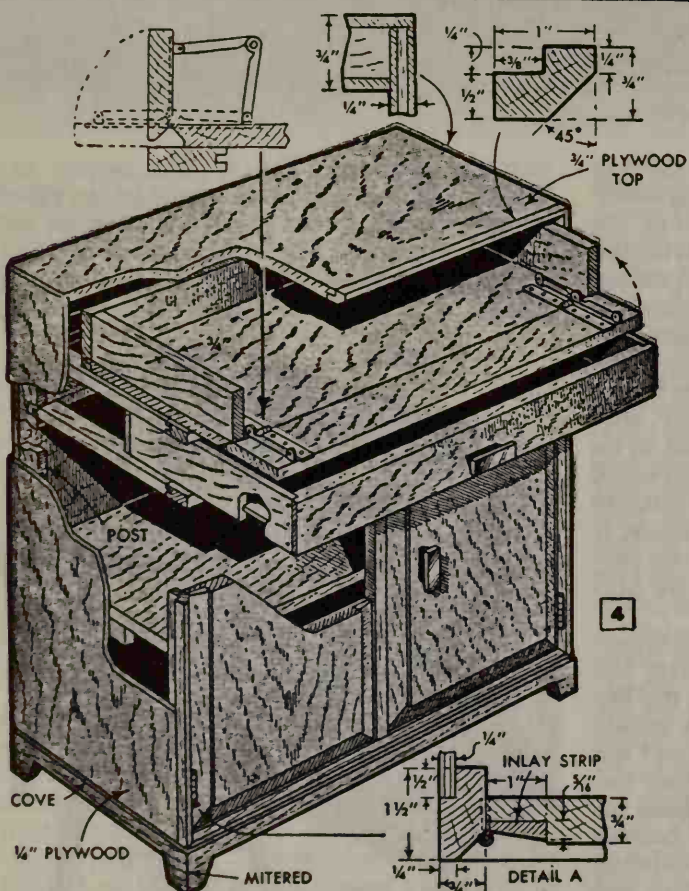
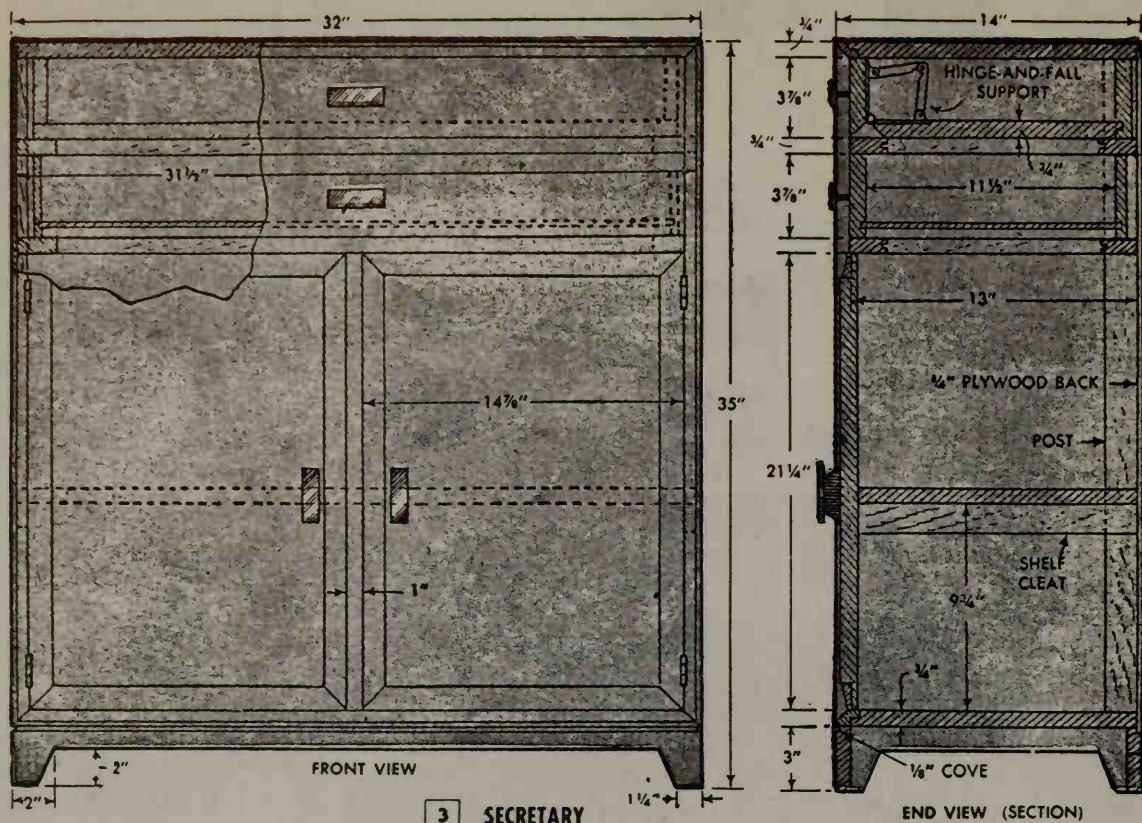


hopper-front effect and at the same time to conceal the laminations of the plywood. Figs. 3 and 4 detail the construction of the secretary. In comparing its construction with that of the other pieces you will notice that much of the construction is duplicated. The bases are all the same, as are the drawers and, in most cases, even the manner in which the plywood panels are fitted. The exception is noted in the window, corner and end unit; which are designed to be flanked by other pieces. Here, the plywood is placed on the inside instead of the outside of the framework. Plywood, $\frac{1}{4}$ in. thick, is used to cover the sides and back of the secretary, while a heavier stock of $\frac{3}{4}$ -in. plywood is used for the top.

Make the base assembly first. The members are mitered at all four corners, the rear member having a rabbet cut in the top edge to take the plywood back. A small, $\frac{1}{8}$ -in. cove is run along the top edges of the other pieces, which can be done either before or after gluing and nailing the base together. The hopper edging which frames the front of the cabinet is shaped according to the sectional details included with the

cutaway drawing, Fig. 4. The center and bottom shelves can be of plywood, or glued up from solid stock. These should be cut $31\frac{1}{2}$ in. long and the front edge of the bottom shelf rabbeted for the hopper edging. Then the bottom shelf is glued and nailed

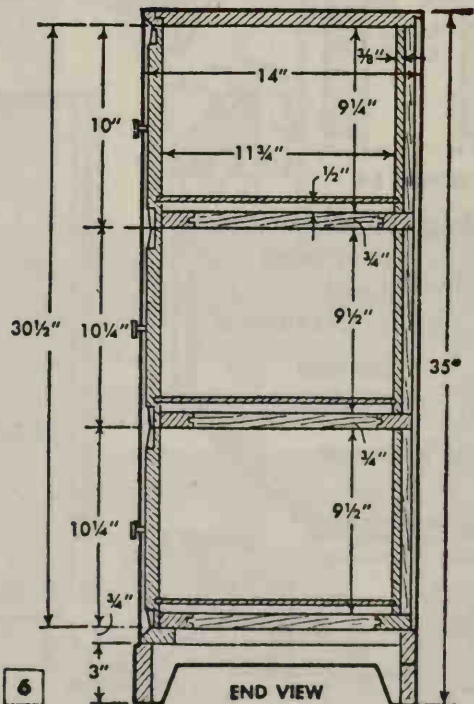
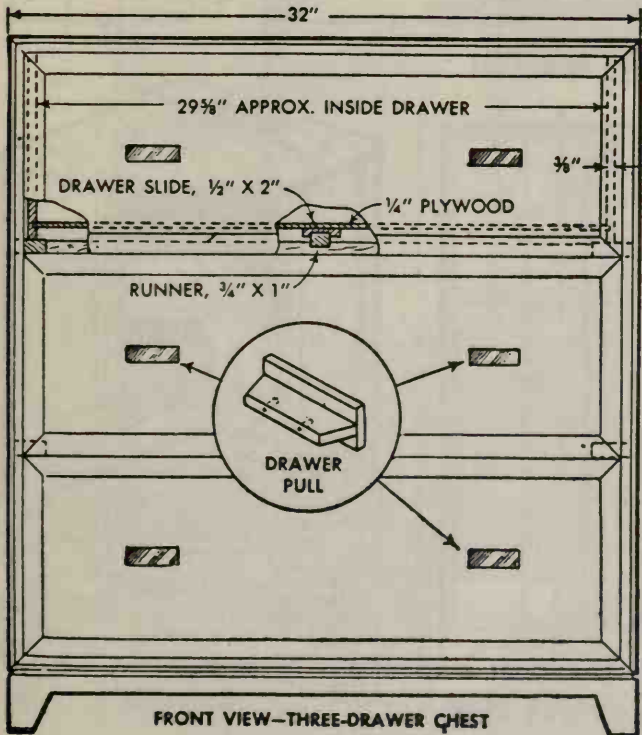
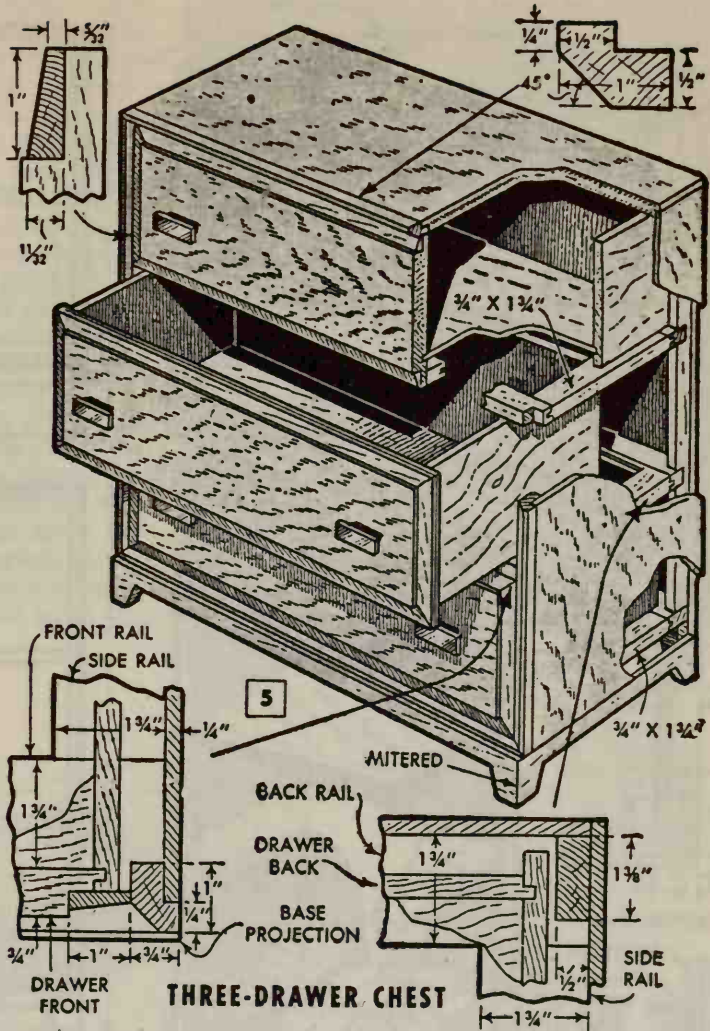


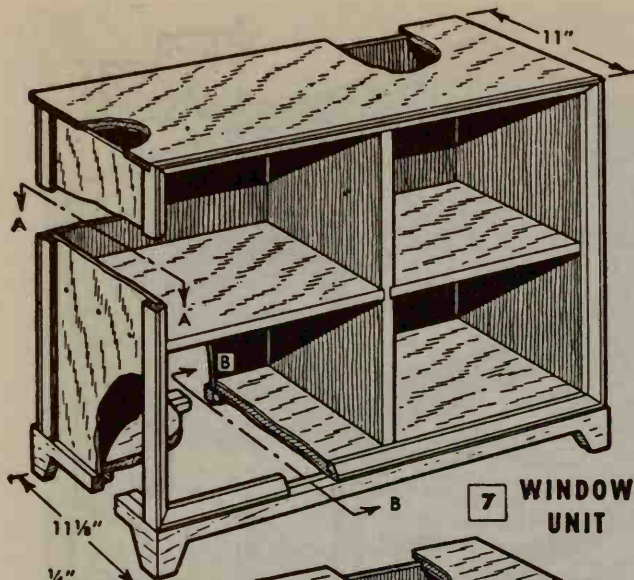


to the base assembly. The $\frac{3}{4}$ -in. top, including the edging, should have the same over-all measurements as the base. This is rabbeted on all four edges. Note at the ends that the rabbets are cut $\frac{1}{4}$ in. deep and to the thickness of the top ply of the wood. The top is supported at the rear corners by posts and at the front by the hopper edging. Frames for the drawer and writing shelf are typical open frames, being assembled from $\frac{3}{4} \times 1\frac{3}{4}$ -in. stock. Inner edges of the front and rear members are grooved to take tenons formed on the ends of the side members. The frames are fitted into notches cut in the rear posts and supported at the front by nailing into them through the edging rabbet. The $\frac{1}{4}$ -in. side panels will probably overlap the edge of the plywood back

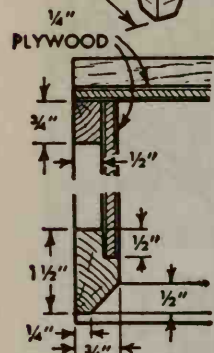
and are cut to fit accurately in the rabbets of the top and in the edging strips. The writing shelf is made similarly to a drawer except that the front is hinged. Note in the sectional detail, Fig. 4, that the bottom edge of the front piece is beveled to match a similar cut made on the front edge of the shelf. A stop should be fitted in the underside of the top to prevent the shelf from being pulled all the way out, and a bullet friction catch installed to hold the drop front closed. Construction of the drawer is apparent from the drawing. Plywood is best for the two doors, but solid stock can be used. In producing the raised-panel effect in plywood, an inlay strip is used to conceal the plies as indicated in detail A, Fig. 4. The door and drawer handles pictured are made up special from $\frac{1}{4}$ -in. brass. Fig. 11 shows how these are soldered together T-shaped and then drilled and tapped for attaching with machine screws. The edges are rounded slightly with a fine file and then the brass is buffed to a high polish. A thin coat of clear lacquer will keep the handles bright.

The three-drawer chest is

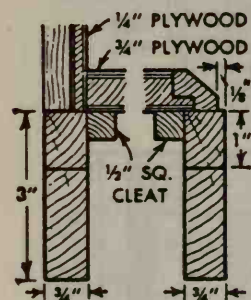




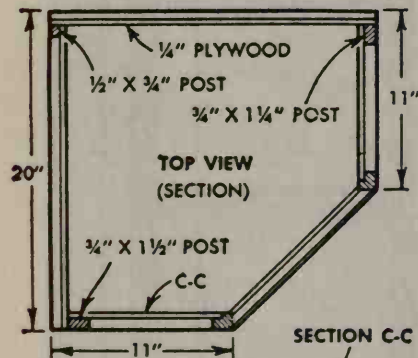
7 WINDOW UNIT



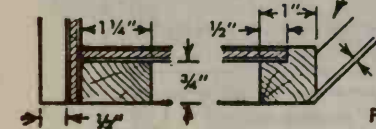
SECTION A-A



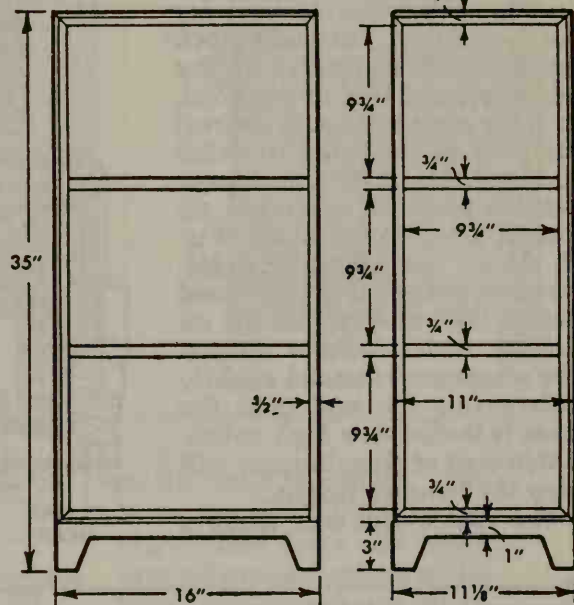
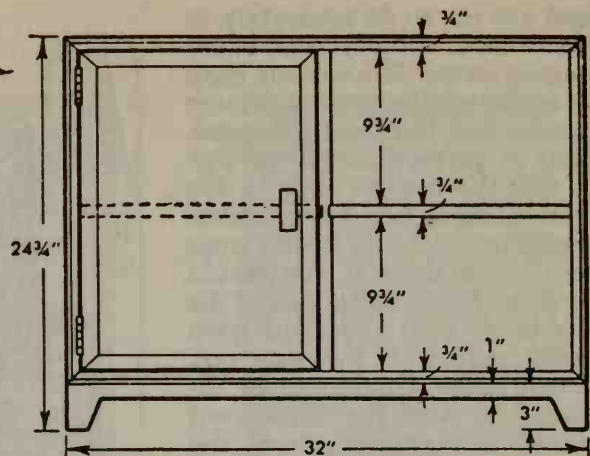
SECTION B-B



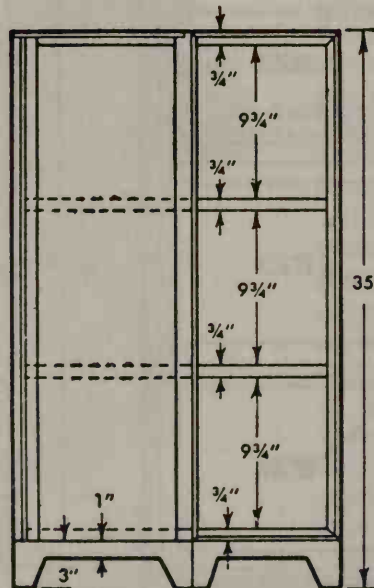
SECTION C-C



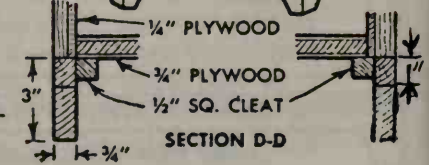
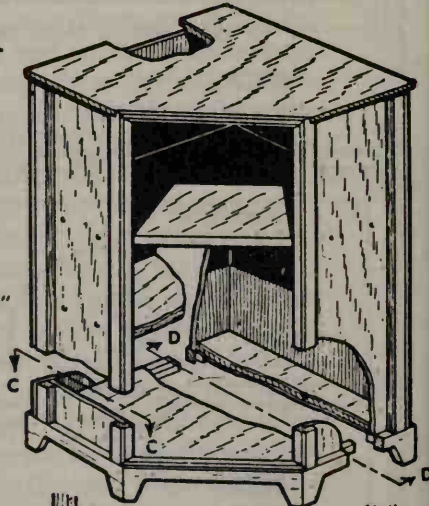
3/4" BASE PROJECTION



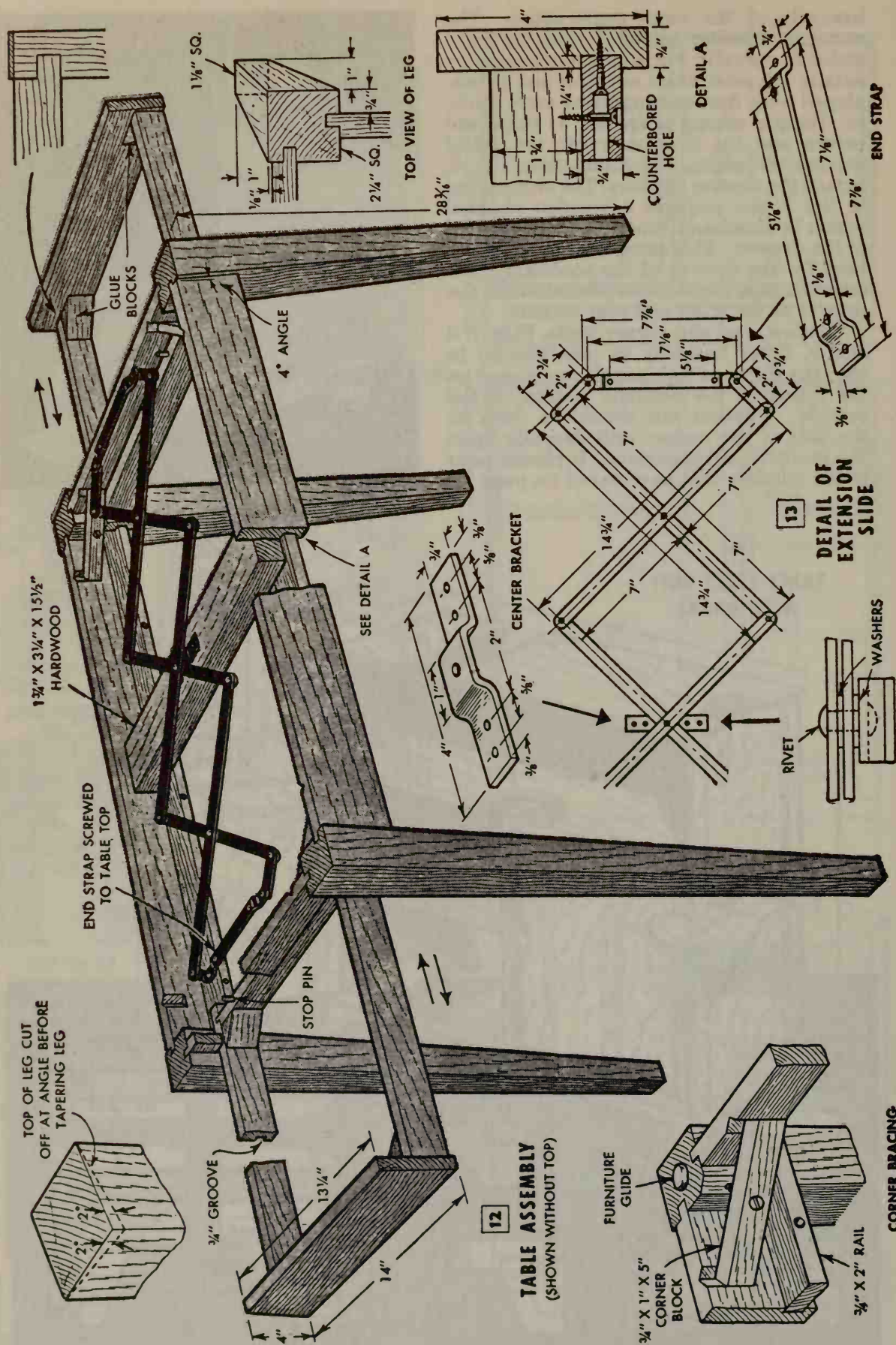
8 END UNIT



9 CORNER UNIT



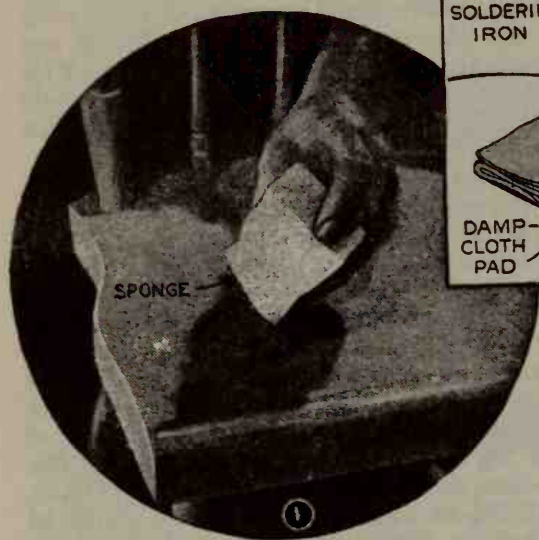
SECTION D-D





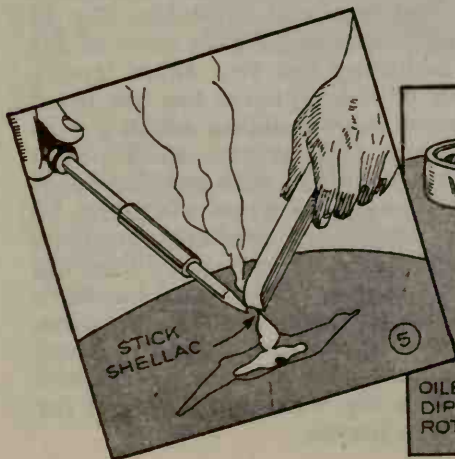
The lazy-tong extension slide is assembled from flat iron and riveted together as indicated in Fig. 13. This is pivoted to a center bracket which in turn is screwed to a hardwood center member installed between the side aprons. Each end of the extension slide is screwed to the underside of the two top leaves of the table. Fig. 14 shows an end view and a plan view of the table top including the two extra leaves. Outer edges of the plywood top are fitted with a mitered edge molding set in a rabbet, and a rule joint is run on the drop leaves for hinging them with regular drop-leaf hinges. When cutting the rule joints, be sure to allow sufficient clearance between the male and female members so that the joints will not bind after the finish has been applied to the surfaces. Note in the plan view that steel dowel pins forced in blind holes in the underside of the top align and guide the table top when extending it for inserting extra leaves.

FURNITURE REPAIR AND REFINISHING



MANY pieces of fine furniture, abandoned because of being broken, seemingly beyond the possibilities of repair, or so badly checked and marred that they need a complete refinishing job, can be brought back to "life" and usefulness by the average home mechanic.

Scratches and checked finishes: Varnished finishes, especially those on table tops, Fig. 3, suffer considerably from everyday usage. If there is only superficial damage such as light scratches, water marks and checking, you can do wonders in renewing the old finish with a liquid called amalgamator which can be obtained at some well-stocked painting supply houses. This liquid applied to the surface softens the old varnish or enamel, causing it to flow and level itself, after which it hardens again. Checked surfaces are

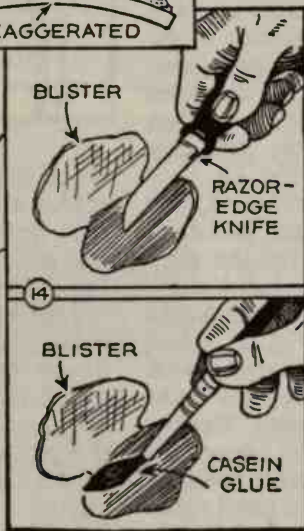
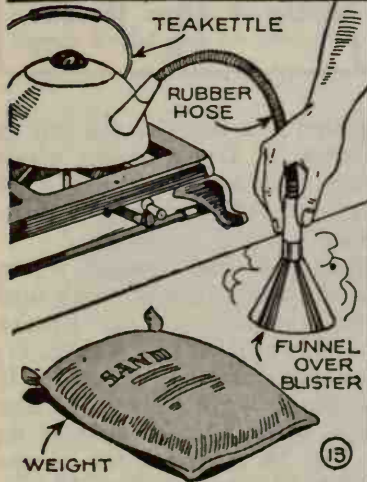
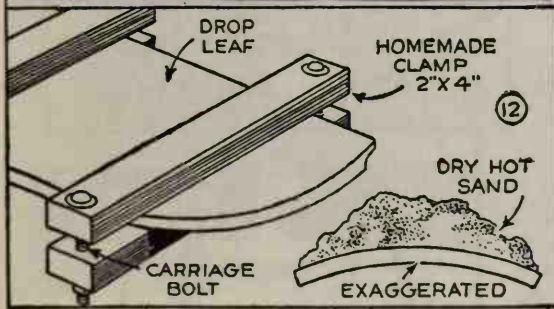
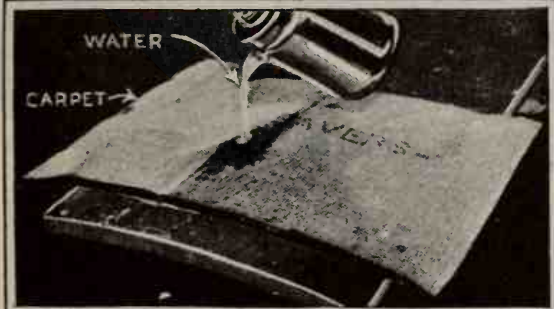




OPEN JOINTS
ARE WORKED
APART, SCRAPED
CLEAN OF
OLD GLUE
AND
REGLUED



Checks in wood are first filled with wood putty, then top-dressed with stick shellac to match the finish, Fig. 9. Knotholes are filled with nonshrinking paste crack filler, Fig. 10. For sealing seams as at drawer bottoms, use calking compound, Fig. 11

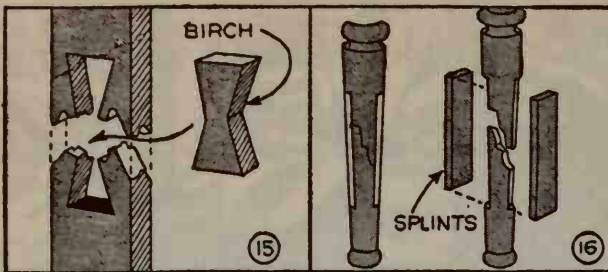


scrubbed with mild soap, using a stiff-bristle brush to remove all dirt from the cracks, and when dry, the amalgamator is flowed on like thin varnish. After this has dried, the renewed surface can be waxed and polished.

Removing dents: If there are shallow dents in the wood, the varnish of the dented surface is removed carefully to bare the wood. Then a few drops of water are applied to the wood as in Fig. 1. The water swells the compressed wood fibers so that they will return to their original position. If simple soaking does not remove a dent, try the heat process. Moisten the wood as before and after the water has penetrated the fibers, put a pad over the dent and hold a hot soldering iron or flatiron on the pad as in Fig. 2. Then stain to match and varnish where the finish was scraped off. When dry apply amalgamator to blend the edges of new and old varnish.

Scars and gashes: Ugly scars and gashes are filled with wood cement commonly known as stick shellac. A stick of appropriate color to match the finish is softened by means of a soldering iron as in Fig. 5 so that it drops into the gash. Do not heat the cement too much or it will char. Heat just enough to flow without bubbling. After filling the gash, smooth the cement with a spatula as in Fig. 4, which should be heated over an alcohol burner, Fig. 7, but do not use a candle or other flame as it contains soot. After the cement has hardened, rub the surfaces with an oiled felt pad dipped in rotten-stone, as in Fig. 6.

Checks, cracks and knotholes: Checks in the wood are unsightly but do not seriously weaken the wood. First fill them to slightly below the finish level, Fig. 9, with fresh wood putty or sawdust



Fractures of legs may be repaired with a double wedge as shown in Fig. 15, but if the legs are too slender you can apply splints as in Fig. 16. Repair pieces should be same kind of wood. Often, corner blocks, glued and screwed in place will hold legs rigidly, Fig. 17

mixed with casein glue. When dry, apply stick shellac to match the finish. Cracks and knotholes not in highly polished surfaces can best be filled with a nonshrinking paste crack filler applied with a spatula as in Fig. 10.

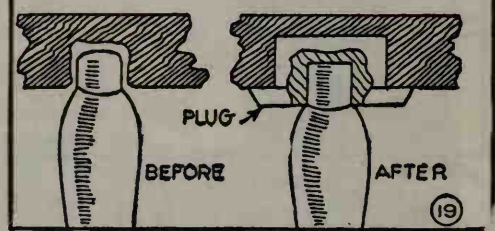
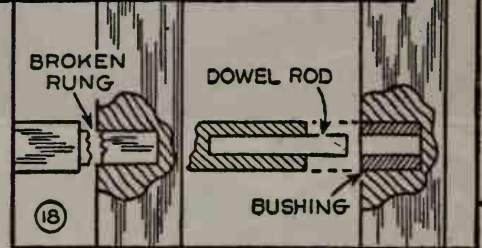
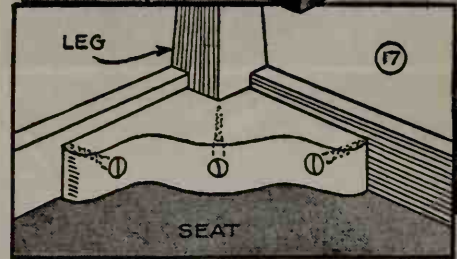
Regluing and filling seams: On a job involving extensive repairs, pieces should be reglued and clamped as in Fig. 8. The edges should be scraped clean of old glue before applying fresh glue. Calking compound settles the old problem of shrunken drawer backs, Fig. 11, as it never gets hard but remains elastic, yet keeps the gap plugged.

Warping: Curved pieces of wood such as found on drum tables and circular-table aprons can be returned to their original shape if you make use of the natural tendency of the wood to warp. As shown in the photo above Fig. 12 a piece of carpet is laid on the convex side and hot water is applied, while the other side is kept dry, allowing free circulation of air. When the wood has reached the desired curvature, place it in clamps or forms to hold it in position until dry. The same method works in reverse to take the warp out of table leaves, Fig. 12. Here a wet pad is put on the concave surface so that wood fibers on this side will absorb moisture and expand. Watch the progress and clamp the leaf when it is straight, leaving it clamped overnight. Should the leaf be bent too far so that it is warped in the opposite direction, hot, dry sand will bring it back as shown in Fig. 12.

Blisters on veneer: If loose or blistered, the wood must be steamed to a pliable state before it can be worked, taking care not to soften the glue that is still holding. A simple steamer can be improvised as shown in Fig. 13. Then a sharp knife is used to cut the blister open as in Fig. 14, after which glue is applied and the wood pressed down in place again, working fast to get the job done before the wood dries out and breaks. Excess glue squeezed out at the edges is wiped away and a bag of sand is placed on the spot as a weight.

Repairing fractures: Fractures often need reinforcing. In Fig. 15, a double wedge of hard-

WEAK LEG JOINTS CAN BE REINFORCED WITH CORNER BLOCKS GLUED AND SCREWED TO THE LEG AND RAILS



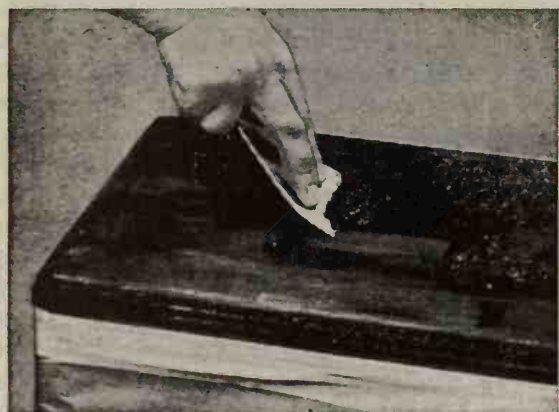
wood is glued in a mortise cut out to make a snug fit. Dress down when dry. Splints such as shown in Fig. 16 are set in pieces that are too slender for a double wedge.

Leg joints and chair rungs: When a leg of a chair or table is weak and needs reinforcement, corner blocks glued and screwed in place, Fig. 17, are sometimes the best solution. If the chair has a rung broken at the tenon, refit with a dowel tenon, as shown in Fig. 18. A repair for an enlarged socket is shown in Fig. 19.

DO A CLEAN JOB OF STRIPPING



Wax-base, paste-type remover stays wet for several hours, allowing plenty of time to soften the paint



Putty knife cannot dig in if corners are rounded. Coarse burlap can be used for clean-off if desired



All finish removed, surface should be cleaned with benzine to remove wax film. Sand smooth when dry

THE ONLY satisfactory way to refinish a piece of furniture is to strip the old finish to the bare wood. In some instances, if the finish is not badly scratched, good work can be done with a fresh top coat of varnish or color varnish. If the job is a table, the top only may require stripping.

Wet, or chemical, stripping is done with solvent solutions commonly called paint removers. They are available in liquid, semi-paste and paste form; inflammable or noninflammable; wax base or wax-free. The noninflammable removers are less powerful, while the wax-free mixtures tend to dry too quickly for convenient use. Hence, the wax-base and inflammable type, while posing a fire hazard and necessitating thorough cleaning up to remove the wax residue, is first choice with most finishers.

Apply the remover with any old, soft brush, laying it on with the flat side of the brush—do not brush out like paint. Let stand at least 20 minutes and then scrape a test area with a putty knife. If the finish comes off clean, go ahead; if not, wait. Give the remover time to work; it will stay soft and keep working for several hours. The actual removal of the paint with putty knife should be done cleanly and systematically, avoiding sloppy work or going over the same spot several times. Round the corners of the putty knife if you want to avoid dig-ins. On delicate veneers it is sometimes best to avoid the putty knife entirely, instead using coarse burlap to wipe off the softened finish. After the finish is removed, the surface should be cleaned with alcohol, benzine or turpentine to remove the wax residue. It is best to do this cleaning-up at least twice, since any wax film on the work can cause no end of trouble.

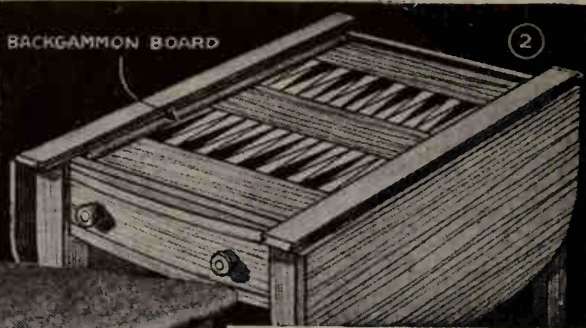
Refinishing is the same as for new wood except that no filler is required unless you sand deep enough to remove the old filler. A bleach can be used to lighten the wood if desired. Some stubborn stains—reds especially—will not bleach and should be treated with a special stain remover. This product can be used alone if the stain itself is the only source of discoloration. The best stain for most off-color refinish work is pigment wiping stain. This is like a thin paint and serves to uniform the color of the wood. Two coats of stain can be applied if one coat does not give an even tone. Pigment wiping stain will work best when applied over a wash coat of shellac or shellac mixing lacquer.

GAME TABLE



Card table for four

BACKGAMMON BOARD



Pull the leaves apart for backgammon

and drop the leaves if you wish, as in Fig. 2, while for chess or checkers you just reverse the insert as in Fig. 4.

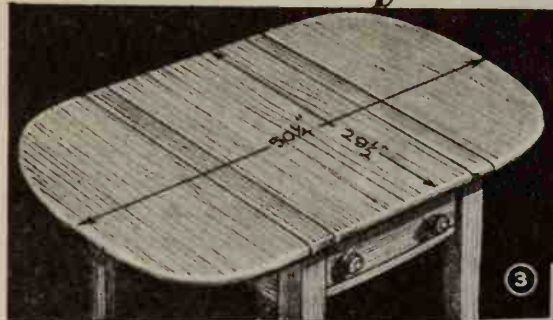
There's no complicated joinery as you might expect, and any craftsman of average skill will find the job of making the table an easy one. The entire construction of the frame is shown in Figs. 5

HERE'S a game table that serves many purposes, being small enough for two persons playing chess, checkers and backgammon, yet capable of instant enlargement so that it is perfectly convenient for four or six persons at bridge or poker. The top consists of two sliding, hinged leaves which can be pulled out and dropped over both sides, and a sliding center insert, one side of which is a checkerboard and the other side is finished to match the rest of the table. A false, sunken top, just below the regular top, serves as a backgammon board, and under this is a large drawer that holds all of your playing equipment.

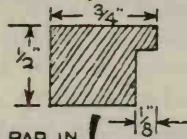
Normally, when used as an occasional table, the center insert with its plain side up, fits snugly between the two folding leaves, which are dropped down. For a bridge table, you slide out the center insert and push in the leaves until they meet at the center as in Fig. 1. When you need space for six, you merely replace the insert and keep the leaves extended as in Fig. 3, which gives a total length of over 50 inches. Then, for backgammon pull out the insert

to 7 inclusive. As you will see, the table is of simple colonial styling, and while it can be made of softwood to keep down the cost, it will be a finer piece if made of hardwood. Start by making the legs. They are 2 in. square at the top and down for a distance of 4¾ in., then tapered to 1¼ in. square at the bottom. Mortises are cut in the top sections of the legs to receive the tenons of the front, back and side pieces. The two front pieces are only 1 in. wide and are spaced for the drawer to fit between them. All the mortises are ¾ in. wide and ½ in. deep. After gluing the joints, a finishing nail can be toenailed through each tenon, from the top, and at an angle into the leg, which will spread the tenon slightly and tend to lock it in position. Next, you install the backgammon board, which also serves to increase the rigidity of the table framework. This is ¾-in. plywood fitted snugly inside the apron and upper front cross-piece. It is glued and nailed to the underside of two rabbeted strips across front and back of the table. See Figs. 5 and 9. These strips serve as guide bars for the sliding leaves, which have corresponding guide bars on their underside to fit the station-

Multi-Purpose



Extra leaf makes a six-hand poker table

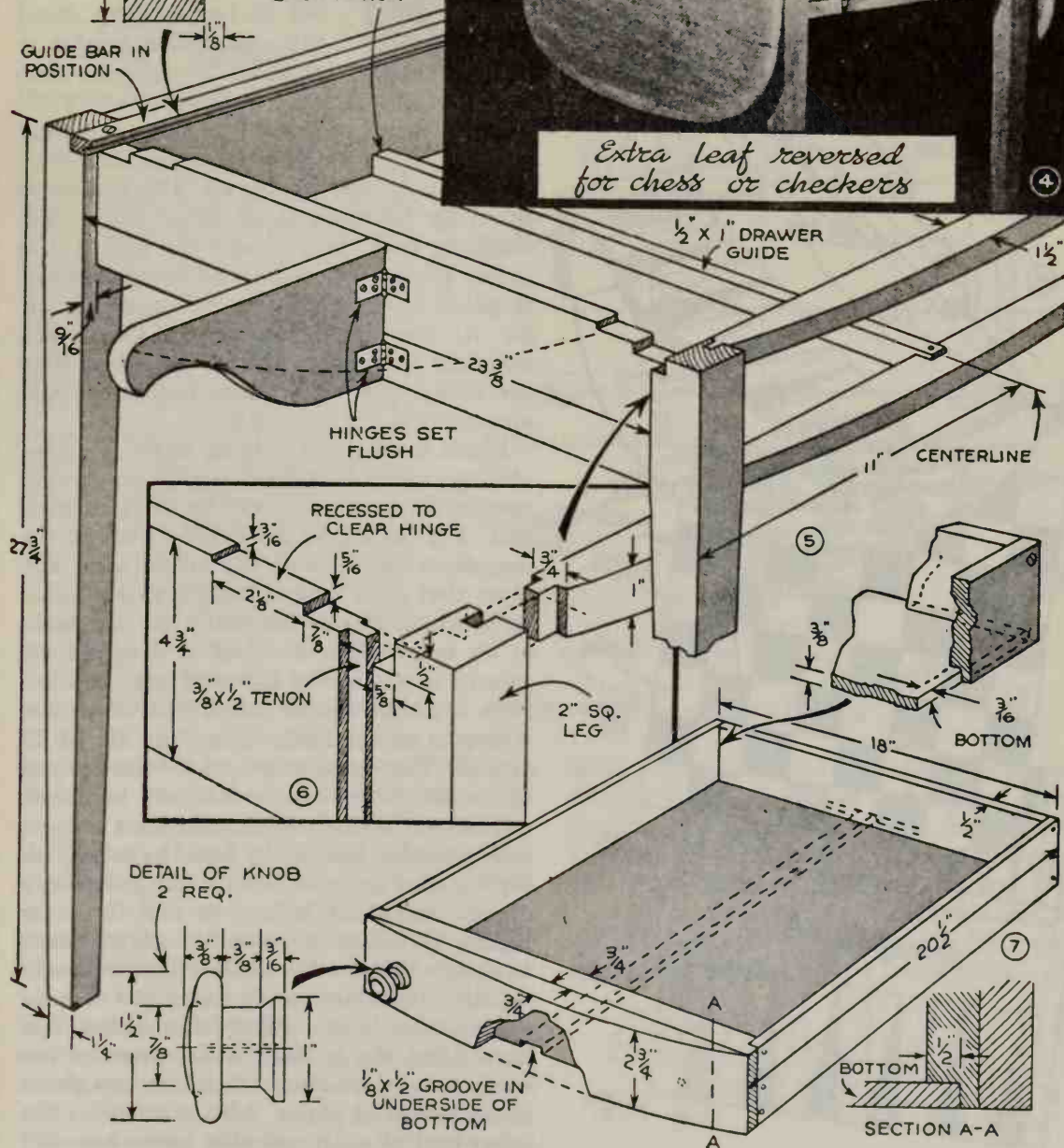


DRAWER GUIDE
MORTISED INTO
BACK APRON

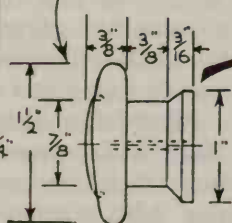
GUIDE BAR IN
POSITION



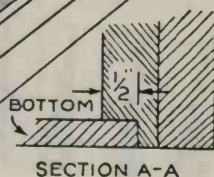
Extra leaf reversed
for chess or checkers

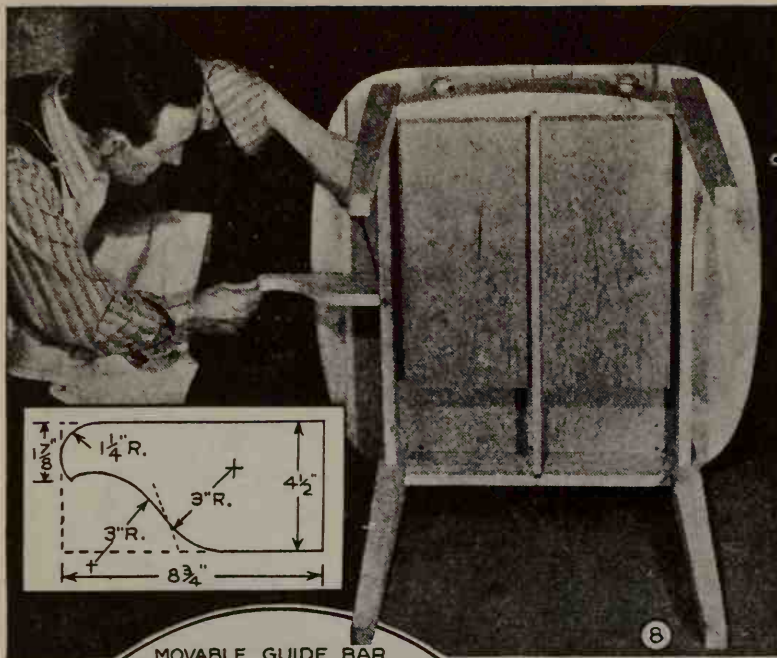


DETAIL OF KNOB
2 REQ.



1/8 x 1/2 GROOVE IN
UNDERSIDE OF
BOTTOM



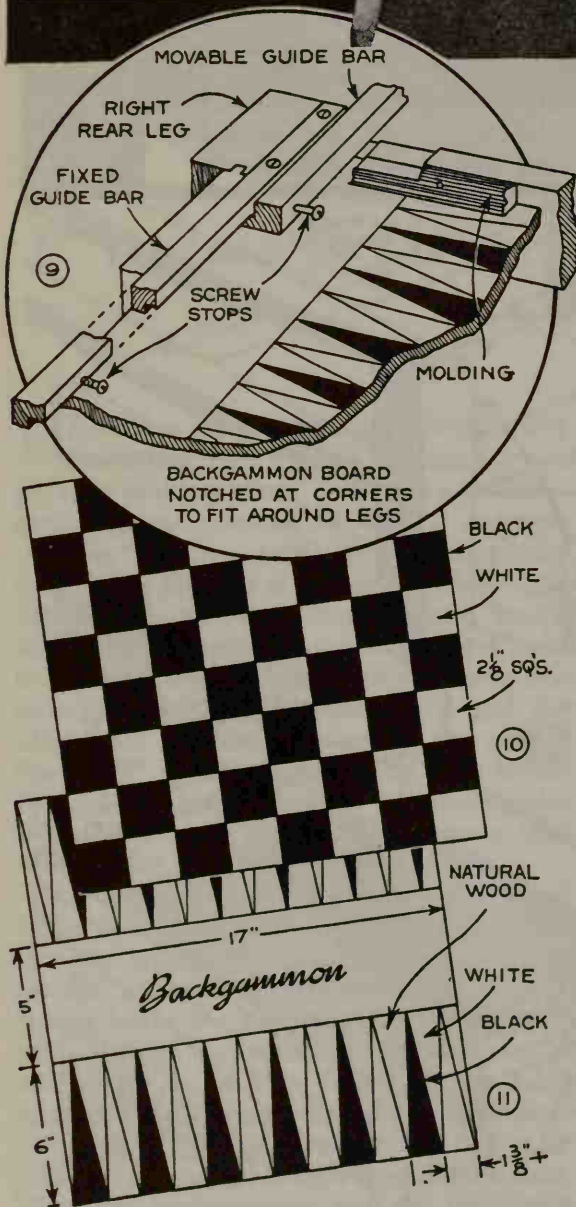


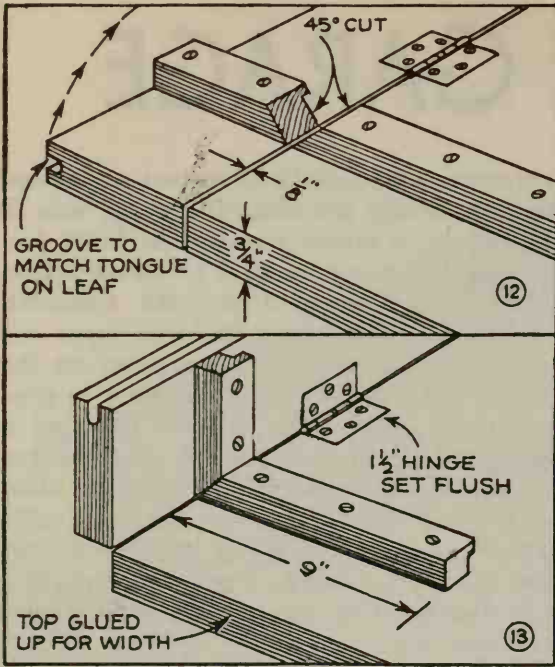
any ones. Quarter-round molding is used to fasten the other two edges of the backgammon board as in Fig. 9. Hard maple is recommended for the guide bars.

The drawer is shown in Fig. 7. The shallow channel cut for the guide rail does not extend through the drawer front but is cut in the bottom only. If no power saw is at hand, this channel may be cut out with a backsaw and a flat chisel. When completed, the drawer is fitted between the front pieces of the table; it should be given just enough clearance to work

freely, yet not so much that there are wide spaces around it. After the fitting has been done, the drawer guide rail (also maple) is fitted by bringing it up from below and marking both the rail and the pieces it is to fit. When located by trial fitting, the rail is glued and nailed into the mortises cut for it. See Figs. 5 and 7. Two hinged brackets to support the leaves when they are raised, are cut and attached to the side aprons as in Figs. 5 and 8.

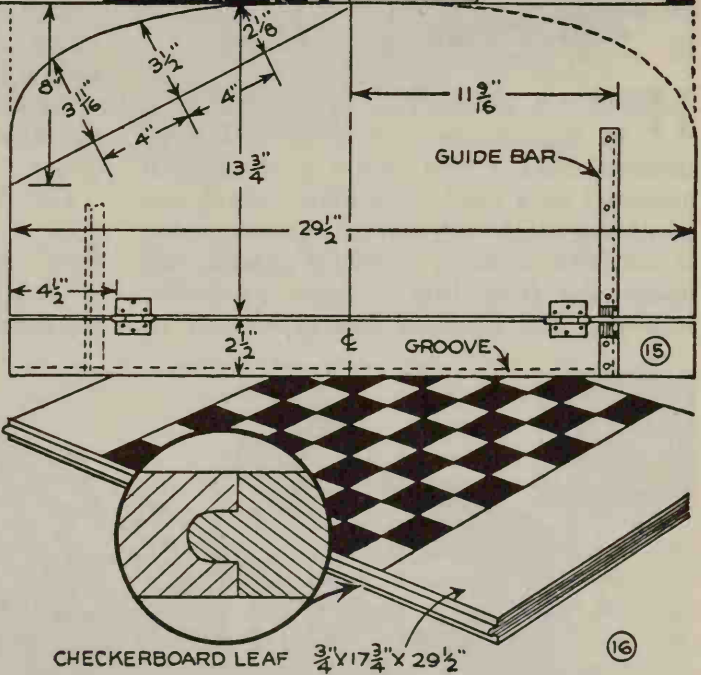
Stock for the top is $\frac{3}{4}$ in. thick. To prevent warping, it is best to glue and dowel two or three pieces together to form each leaf. Fig. 15 shows the correct curves, dimensions, location of the guide bars, etc. Note that each leaf is hinged to a narrow strip which lies horizontally on the table at its edge when the leaf is dropped. A groove is cut in the exposed edge of each strip to fit the center insert leaf which has a tongue on each side. See Figs. 12, 13, 15 and 16. The outer edges of the leaves and the ends of the center leaf are rounded, which can be done accurately on a shaper, and is sanded smooth by hand as in Fig. 14. Before gluing and screwing the guide bars on the leaves, it is best to nail these on lightly and then make minor adjustments to assure that the top units will slide freely on the stationary guide bars, yet not be excessively loose. After this fitting has been done, the permanent locations of the bars are marked after which they are glued and screwed in place. Also, a screw at the inner end of each movable guide bar will





prevent the leaves from coming off the table entirely, as the screws stop outward movement at the point where the leaves are dropped. These screws are shown in Fig. 9. The movable guide bars are cut at a 45-degree angle at the joint where the two parts of each leaf are hinged. See Figs. 12 and 13, which also show where the hinges are located. As the hinges project slightly from the underside of the leaves, the aprons at both sides are notched to permit the hinges to move in and out freely.

Layouts for the checker and backgammon boards are shown in Figs. 10 and 11. You can paint or stain the design on the surface of the wood, or if you like, you can enhance the appearance greatly by inlaying or overlaying. For both inlay and overlay work, woods such as holly (light), and ebony (black) give the needed contrast. Final finish of the table is determined mainly by the wood used and therefore only general suggestions can be made. If mahogany, oak, or other open-grained wood is used, a liquid stain is first applied. This is permitted to dry overnight. Then a coat of paste wood filler is brushed on. If necessary, it can be thinned with turpentine. When the filler begins to appear dull, rub across and with the grain with cheese-



cloth. After another overnight drying, the surface is sanded lightly and several coats of clear varnish are applied, drying and sanding between coats. Maple and birch woods are finished similarly, except that no filler is required. A thin shellac coat is applied over the stain, allowed to dry overnight, then sanded before varnishing.

GARAGE



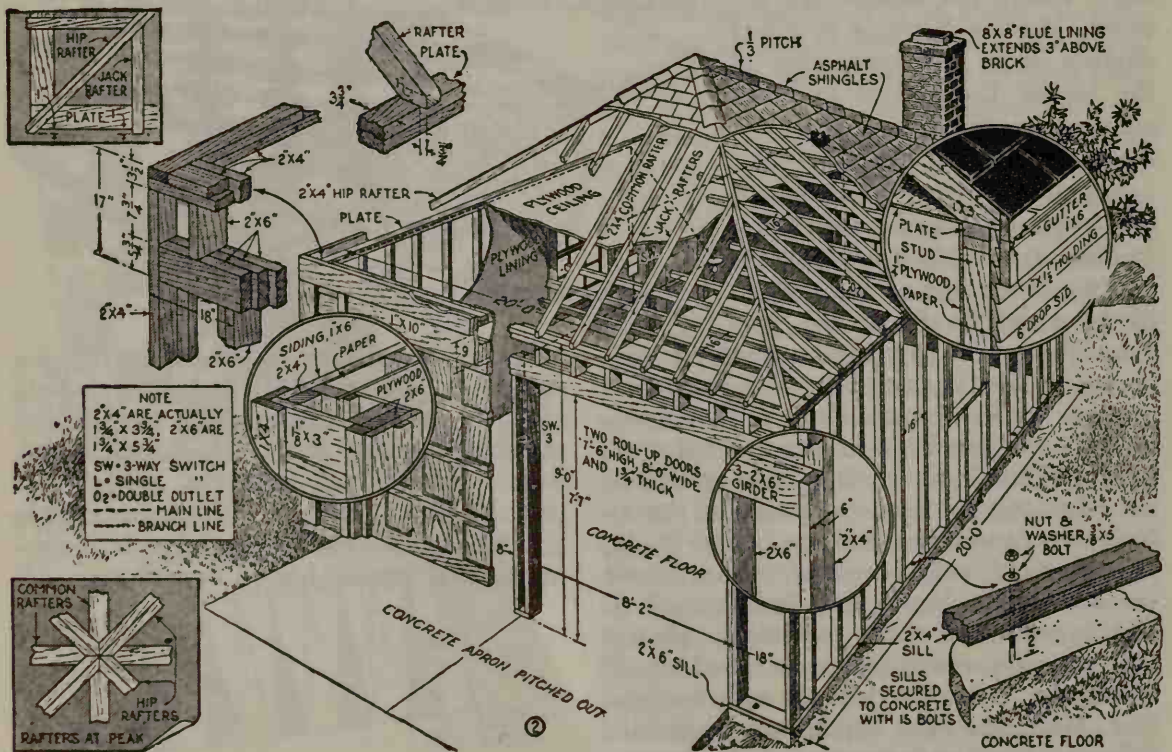
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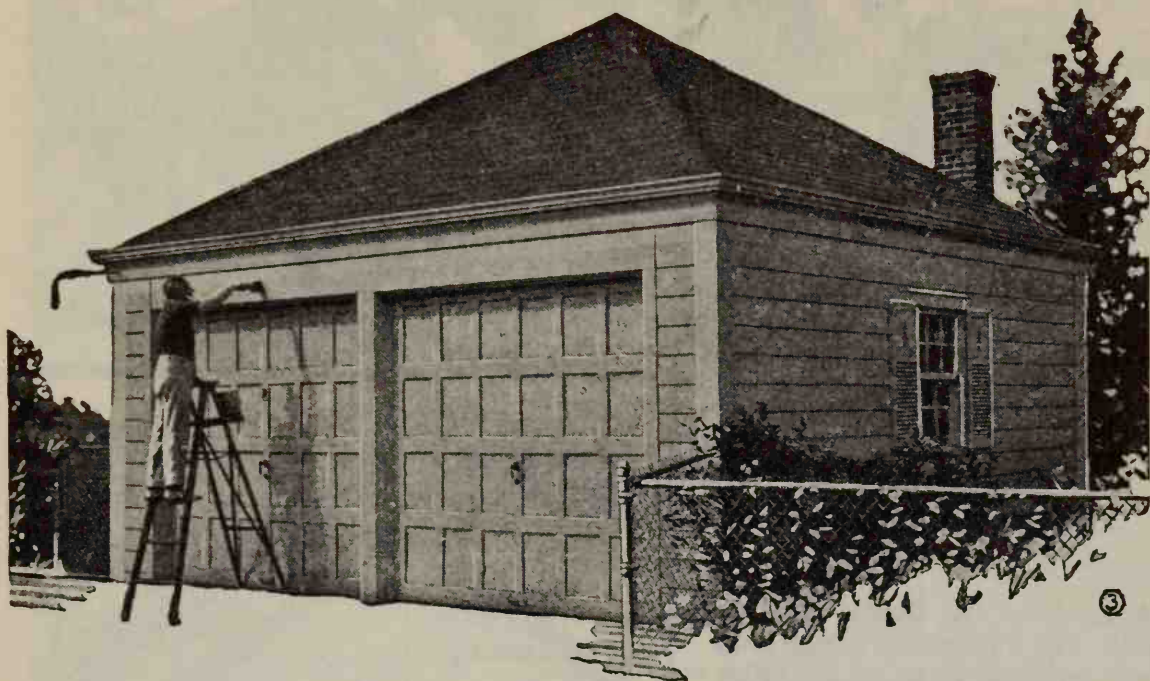
HERE'S a garage that is not only neat in appearance, but is so well constructed that it will stand indefinitely if mounted on a good foundation, which can be of the "slab" type or of the wall type. If the latter is used, it should extend well below the frost line in your particular locality. The floor, of course, should be

concrete, and should have two under-car drains. While the original garage was 20 ft. square, a larger one can be built, following the same method of construction. The walls are covered with Colonial-style siding over heavy building paper and the walls and ceiling are covered on the inside with plywood. A chimney is provided for heat in the winter. The roof is steep to help prevent snow from collecting on it, and the eaves are flush with the sides of the building for economy, and to facilitate closing up the rafter ends. Windows are the tight-closing, check-rail type, and are decorated on the outside with attractive shutters.

A service door is provided, and the front doors are the easy-action, roll-up type shown in Fig. 1. They can be arranged to open either by a key or electrically. Lights can be controlled from the front or service doors.

Construction as shown in Fig. 2 starts with an ordinary concrete foundation and floor. Any good contractor will lay it or you may do the work yourself. Wall framing is spaced 16 in. on centers with double





plates, headers and triple framing around the front doors, to secure a rigid, well-built structure. First lay out and cut the pieces for the sills, as the holes for the bolts which fasten them to the concrete footing must be located and drilled. Then cut the plates and lay the lower ones next to the sills for marking out the centers of the studs on both pieces. Fig. 4 shows the location and size of the various openings.

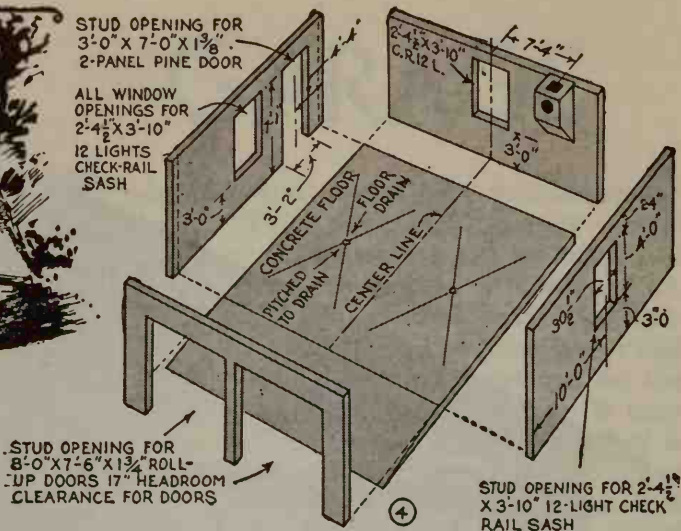
The sills are bolted into place, the corner members erected and held plumb with stay lath and a temporary crosspiece nailed on the outside between corners, against which the studs may be set. The lower plates, supported by one or two studs, are next installed, after which the rest of the studs may be spiked into place. Considerable waste can be avoided if the studs at the door and window openings are omitted when setting up the wall framing, and later cut to size before installing. The common practice is to install them all and then cut out the openings later. Installing the top plate completes the wall framing.

Fig. 14 shows a typical window and door framing. Note that the rough or stud openings are made about 1 in. larger all around than the size of the frames to allow for squaring and setting plumb. The special

framing around the large doors is shown in detail in Fig. 2.

Before putting on the siding, a strip of heavy tar paper is stretched across the studding and secured temporarily with pieces of lath. Standard drop siding in a design to simulate bevel siding is used. The siding is started at the bottom, working up and adding paper as required. This material is inexpensive and makes a reasonably tight joint when used with paper. The corner joints of the siding are covered with corner boards as in Fig. 9. By lapping the siding at the corners as shown, the nails are placed a safe distance in from the ends of the boards.

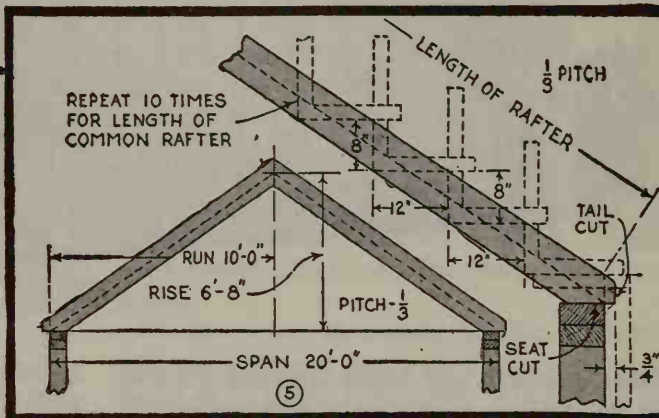
The hip roof has four equal sides so the framing is simplified because of duplicate parts. The pitch of the roof is $\frac{1}{3}$, or for every 12 in. of run there are 8 in. of rise. So for 10 ft. of run there is a rise of 6 ft. 8 in. at the peak, as shown in Fig. 5. There are three types of rafters in this roof. These are shown in Fig. 8 together with the cuts on the ends. To obtain the length of the common rafters, with the tail and seat cuts, place the square along the piece as shown in Fig. 5. However, as the rafter is mitered at the top, as shown in the detail of the peak in Fig. 2, a deduction of



1 1/4 in. from the length must be made. Fig. 8 shows by dotted lines the length and shape of the rafter before making this deduction. Notice that the cheek cut remains at the same angle.

As the hip rafters run diagonally to the common rafters, we use the diagonal of 12 in. or 17 in. as our unit of run. Setting the square at 17 and 8 you proceed just as for the common rafters in obtaining the length of the hips. The seat cut is the same also, but the tail and top cuts are mitered. In order to provide a level surface on which the roof boards may be nailed, bevel or "back" the edges of the hip rafters as indicated. The lines are located on the ends with a square then carried along the sides for sawing.

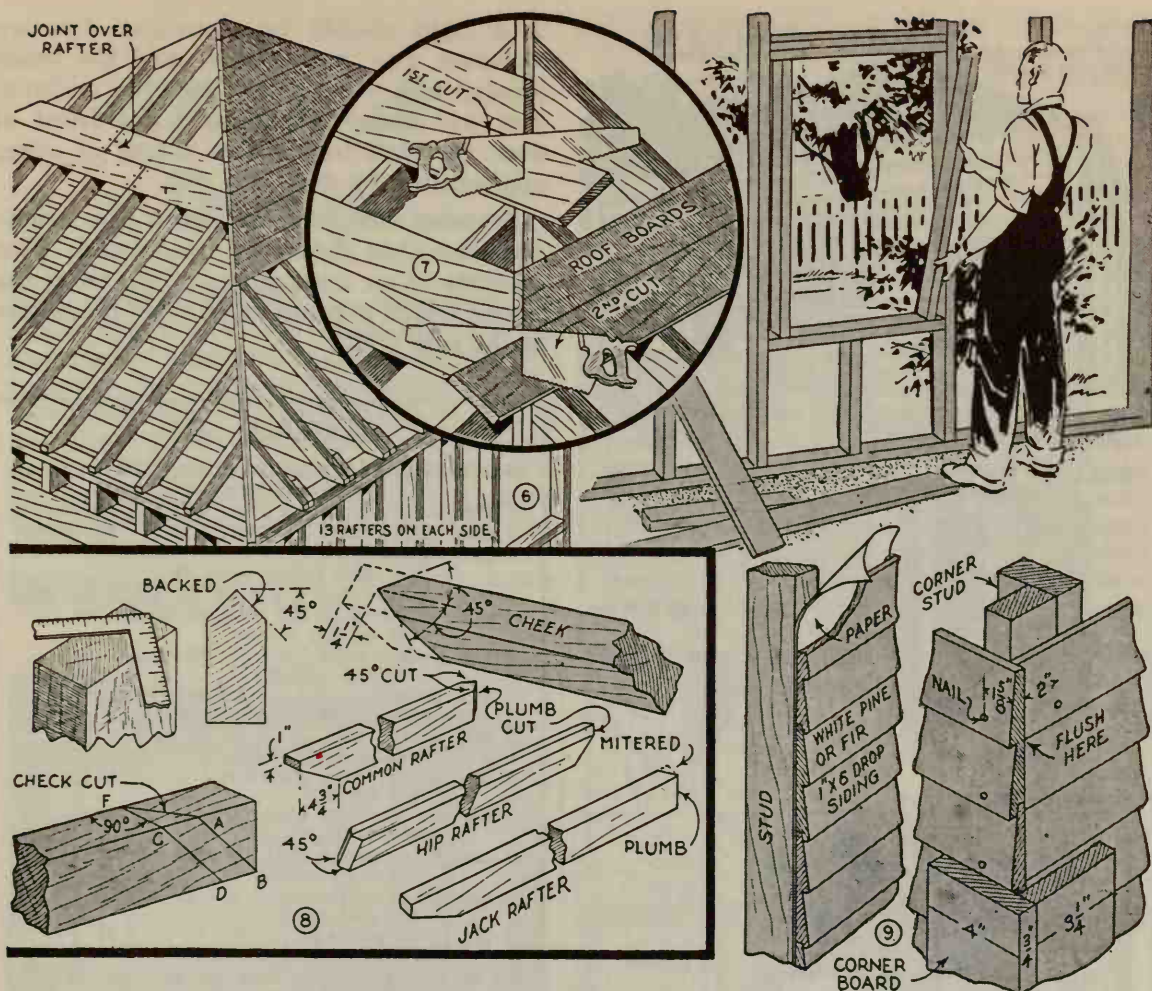
Perhaps the easiest way for the novice to determine the lengths of the jack rafters is by actual measurement of one set after the hip and common rafters are in place. The tail and seat cuts are made on six pieces of various lengths and these pieces held in position and marked, after which they may be used as patterns for the other seven sets. The miter cut at the upper end, by which they are fitted against the hip rafters, is determined in the following manner: First lay off the plumb cut A, B, just as for a common rafter. Now measure



the thickness of the rafter and draw the parallel line C, D. Square across the top to point F. A line drawn from F to A and A to B will indicate the line of the miter.

After all of the rafters have been installed, the ceiling joists should be fitted and securely spiked to both the plates and the sides of the rafters. To lay the roof boards, start at the bottom, nailing two or three boards in place then sawing off the waste stock at an angle so that the end is flush with the adjacent side of the roof, as shown by the first cut in the detail of Fig. 7. Proceed in this way to the peak. Now start the adjacent side in a similar manner, lapping the ends of the first side and sawing at the angle shown as the second cut in the detail. Follow around the roof, taking care that all joints occur over rafters as in Fig. 6. Either square-edge or tongue-and-groove boards may be used but the latter are generally considered preferable. A good grade of individual shingle, laid 4 in. to the weather, Fig. 10, completes the roof.

A molded metal gutter is used all around



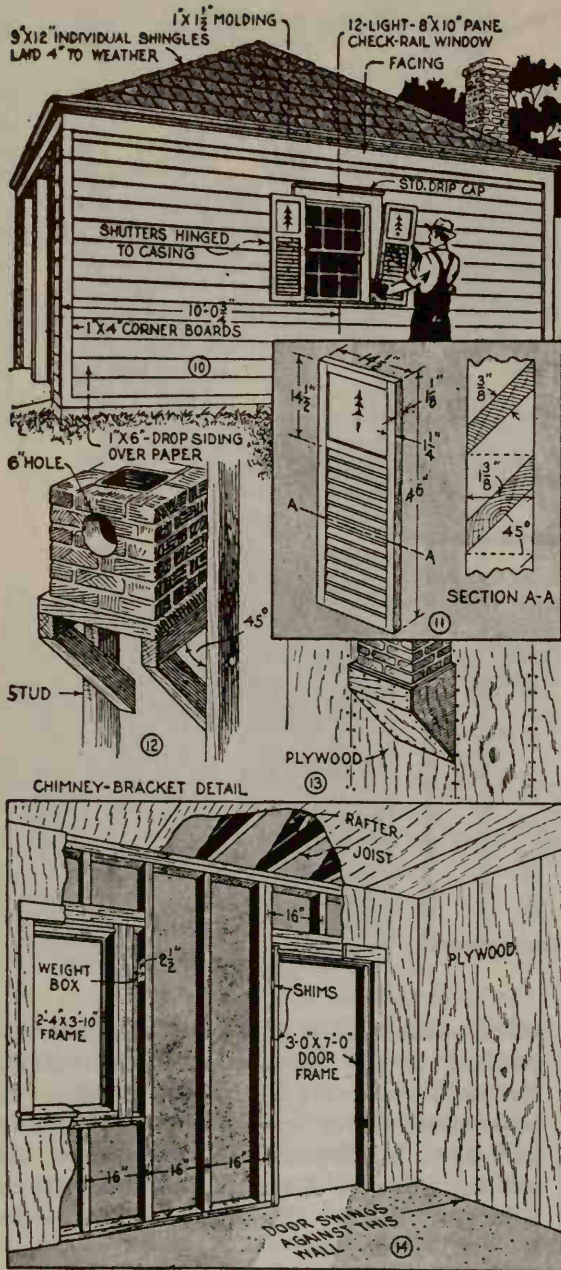
the roof to finish off the edges. A slight pitch should be given to the gutters so that they drain toward the back corner where a downspout is provided to empty into the drain. Standard window and door frames, sash and doors are used throughout. The shutters, however, are of special design, with fixed louvers, as shown in the detail of Fig. 11. Figs. 12 and 13 show the details of the chimney and the bracket upon which it rests. Any good coal, oil or gas-fired heater of suitable size will keep this well-constructed garage at a proper temperature in the coldest weather.

Overhead doors are perhaps the greatest advance in garage equipment in recent years. There are several rather similar makes on the market, any of which is entirely satisfactory. Most of these doors are divided into sections horizontally and operate on a track. Because of a counterbalancing device, they operate so easily that even a small child can open or close them. All of them can be unlocked from

either side and if properly installed, according to the manufacturer's directions, should last for the life of the garage. The two essentials for the use of these doors are sufficient headroom, and rigid door and ceiling framing, Fig. 2, so that the tracks will stay in line. Both are well provided for in this design.

There are also available several types of electric operators for overhead doors which are practical and very convenient as they may be operated from a distance and thus make it unnecessary to get out of your car to open or close the doors.

The proper installation of electric lights and control switches adds greatly to the convenience of a garage. A suggestion is given in Fig. 2. The usual center light should be controlled by three-way switches at both the center column between the large doors, and also at some point near the service door. Another convenience is an outside light near the corner so that it will light both the front and service doors.



This light should be controlled by two switches, one in the house and the other located near the service door. In addition you will want outlets near the front of each car stall for trouble lamps or other appliances.

A water line in the garage is also a convenience that should be considered. This consists of an underground line from the house which is brought up near the center of the rear wall.

MATERIAL LIST

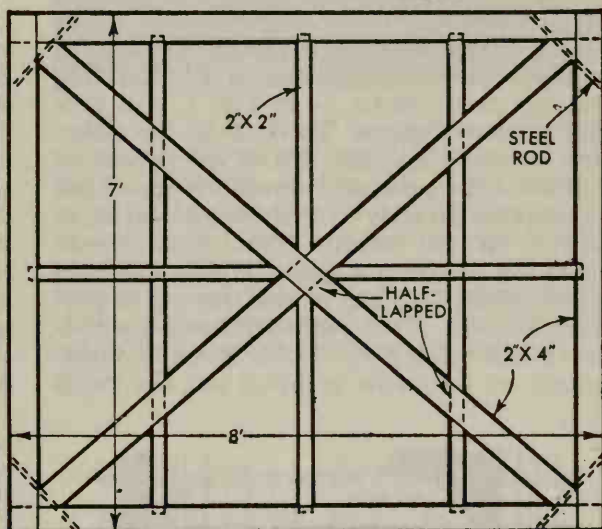
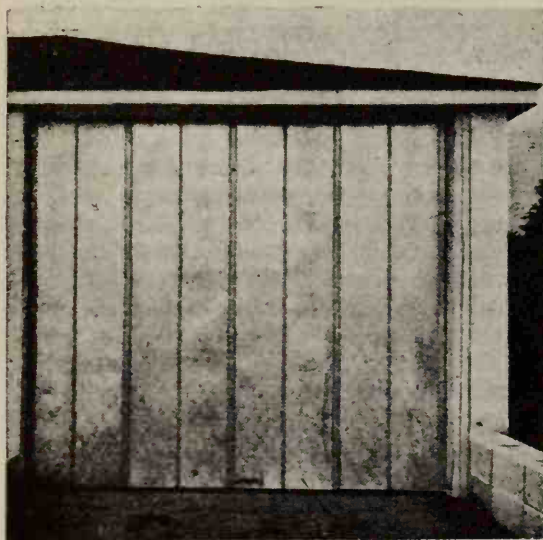
- 60 pcs. yellow pine 2 x 4 in. by 10 ft.
(for studs and corners)
- 10 pcs. yellow pine 2 x 4 in. by 16 ft. for plates
- 3 pcs. yellow pine 2 x 6 in. by 20 ft. for girder
- 9 pcs. yellow pine 2 x 6 in. by 8 ft.
(for door studs, sills, etc.)
- 3 pcs. yellow pine 2 x 4 in. by 20 ft. for sills
- 15 pcs. yellow pine 2 x 4 in. by 20 ft.
(for ceiling joists)
- 4 pcs. yellow pine 2 x 4 in. by 18 ft.
(for hip rafters)
- 16 pcs. yellow pine 2 x 4 in. by 14 ft.
(for common jack rafters)
- 18 pcs. yellow pine 2 x 4 in. by 12 ft.
(for jack rafters)
- 4 pcs. fir or white pine 1 x 3 in. by 20 ft.
(for cornice)
- 4 pcs. fir or white pine 1 x 6 in. by 20 ft.
(for facing board)
- 6 pcs. fir or white pine 1 x 6 in. by 8 ft.
(for door casings)
- 2 pcs. fir or white pine 1 x 3 in. by 8 ft.
(for door trim)
- 1 pc. fir or white pine 1 x 8 in. by 8 ft.
(for door division panel)
- 720 sq. ft. yellow pine matched roofing, 1 x 6 in.
- 720 sq. ft. fir or white pine drop siding, 1 x 6 in.
- 20 fir plywood panels, $\frac{1}{4}$ x 48 in. by 10 ft.
(for walls and ceiling)
- 2 overhead doors $1\frac{3}{4}$ in. by 8 x 7 ft. 6 in.
- 1 two-panel fir service door $1\frac{3}{4}$ in. by 3 x 7 ft.
complete with frame, trim and hardware
- 3 check-rail windows with 12 lights, 2 ft. $4\frac{1}{2}$ in.
by 3 ft. 10 in. complete with frames,
trim, etc.
- 600 sq. ft. asphalt shingles
- 80 linear ft. molded gutter with downspouts
- 600 sq. ft. building paper



GARAGE DOOR

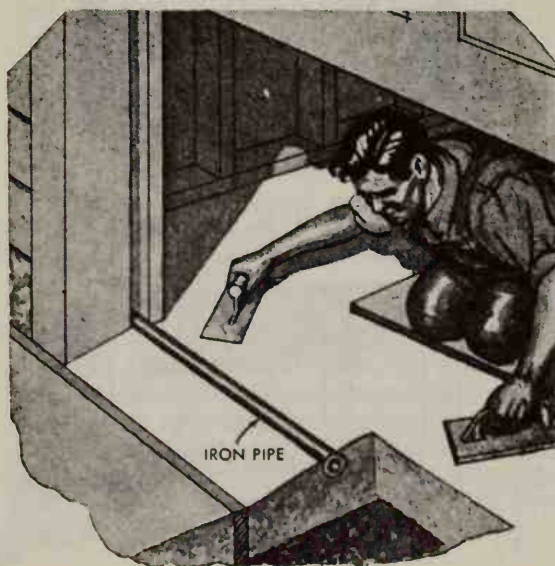
THE HOMEOWNER who constructs his own garage soon comes face to face with the high cost of ready-made garage doors. This cost can be trimmed substantially if he makes his own door, such as this one, faced with sheet aluminum. Sturdy and weather-proof, it will give years of satisfactory service. In building a door of this type, a strong well-braced frame is necessary. The outside members are 2 x 4s, lap-joined and fastened with bolts at the corners. To insure that the frame will remain square, 2 x 4

diagonal braces are fitted and half-lapped. The ends of the diagonal braces are held in place by steel rods that pass through the outside members and the braces. Nailing strips, to which the metal is to be secured, are 2 x 2s, mortised into the outside frame and screwed to the diagonals. To prevent mildew, the frame should be given a coat of wood preservative. Two types of aluminum sheets are available, corrugated and V-embossed. Of the two, the corrugated sheet is probably best for this purpose because it is more rigid, but either can be used successfully. The aluminum must be fastened with aluminum nails or the metal will be eaten away by electrolytic action where it contacts the nails. The inside face should be covered with either plywood or hardboard, and thin blanket insulation may be placed between the frame members. Regular door hardware is used to hang the door. Dimensions given can be varied to suit your needs.



Iron Pipe Laid in Concrete Floor To Provide Door Threshold

When laying concrete in doorways of garages, a $\frac{3}{4}$ -in. pipe provides a threshold that has no sharp edges or bulkiness to injure auto tires. Leveled properly and anchored to the door frame, the pipe will not bend when concrete is poured over it. It acts as a straightedge and guide for an even finish. The surface of the concrete inside the building should be almost flush with the pipe. On the outside it should be lower, slightly above the longitudinal center of the pipe, and sloped downward to provide a watershed. Less than half of the pipe should be exposed to be sure of proper anchoring. The threshold will serve either overhead or hinged doors.



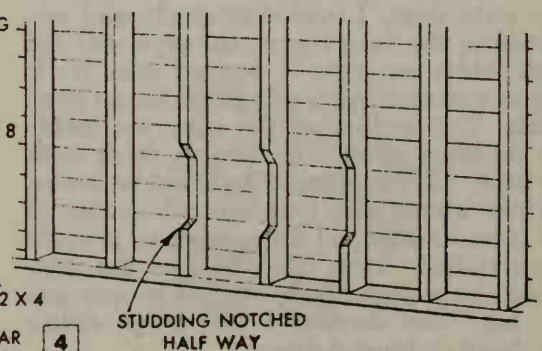
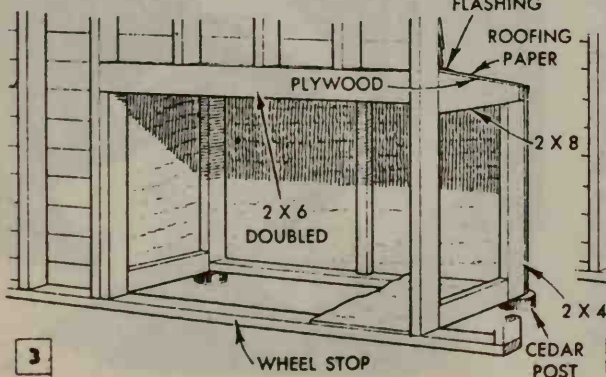
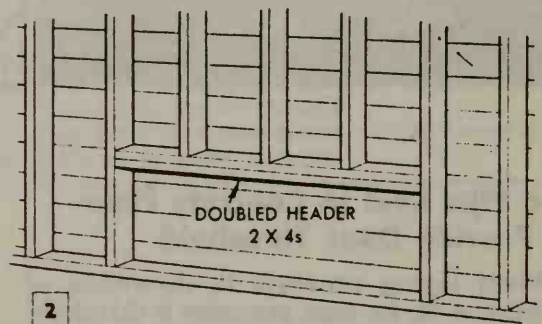
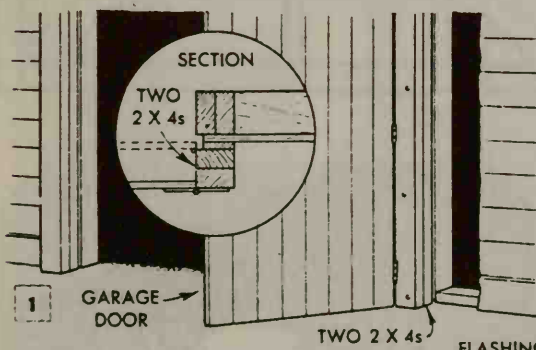
GARAGE ENLARGING

NEW CARS and old garages just don't go together. Whether the rear bumper extends an inch or a foot beyond the wall line, the problem is essentially the same—how to gain the extra space needed to close the doors. In some cases, the doors will close but the short length of the building leaves no room for walking around the car to the side door. Easing into such a restricted space without knocking out the rear wall of the building is an added inconvenience, especially when the car is used every day.

There are several ways of stretching an old garage so that new car will fit in it with room to spare. The method used will depend on the construction of the building, the type of doors used, and the amount of room needed. If, for example, the doors swing outward and it happens that the car bumper extends only 3 or 4 in., building out the door jambs, as in Fig. 1, will give the required space. To do this, the doors are removed and two 2 x 4s are spiked or bolted to the sides and across the top of the doorframe directly over the trim boards, as shown in the detail. This arrangement gives the maximum space. Provide a wide sheet-metal drip cap across the top to prevent leakage. Then paint all the new woodwork and rehang the doors. It may be necessary or desirable to build out the ramp

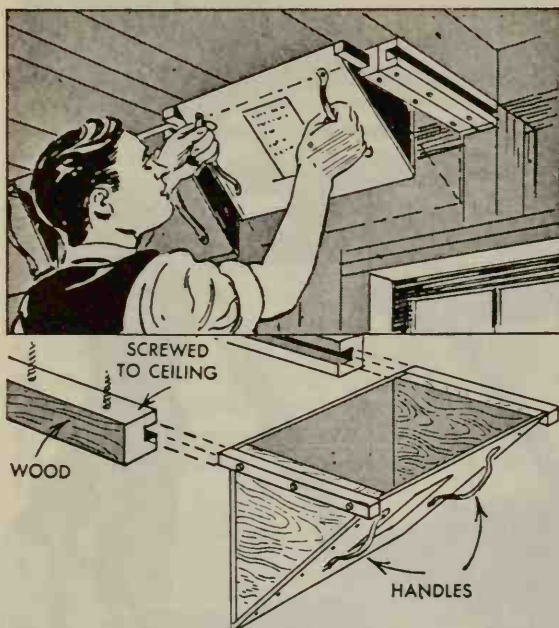


to close an open space under the doors. When an overhead door has been installed or where the doors are of the folding type that rolls on an overhead track along the inside of one wall, about the same amount of space can be gained at the rear wall of the building by using the methods shown in Figs. 2 and 4. Where still more room is required, the lean-to structure detailed in Fig. 3 is the most practical solution. This is built high enough to clear the car hood. Use of waterproof plywood sheathing and flooring simplifies and speeds up this job.



GARAGE STORAGE

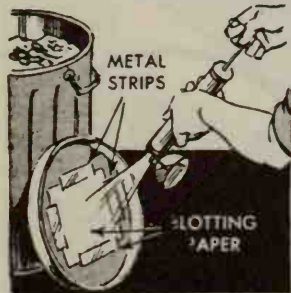
Bins Under the Garage Ceiling Store Needed Articles



The only space generally not used in a one-car garage is the area just under the roof at the top of the walls. But this space is suitable for hanging removable storage bins in which automobile parts, tools, polishes, cleaning cloths and other miscellaneous articles can be kept. The bins are made of plywood or hard-pressed board and are attached by hardwood cleats which slide in grooved wooden strips screwed to the ceiling. A pair of handles attached as shown make removing the bin easy, and a paper label glued or tacked to the front identifies the contents.

Garbage Cans Are Disinfected By Spraying on Blotter

To disinfect his garbage can, one householder secured a large square of blotting paper to the underside of the can lid. Then



at regular intervals the blotter was sprayed with disinfectant. Because of the absorbent nature of the paper, it retains the spray longer than would the metal surface of the can lid.

Extra Storage Space in Garage Provided by Platform

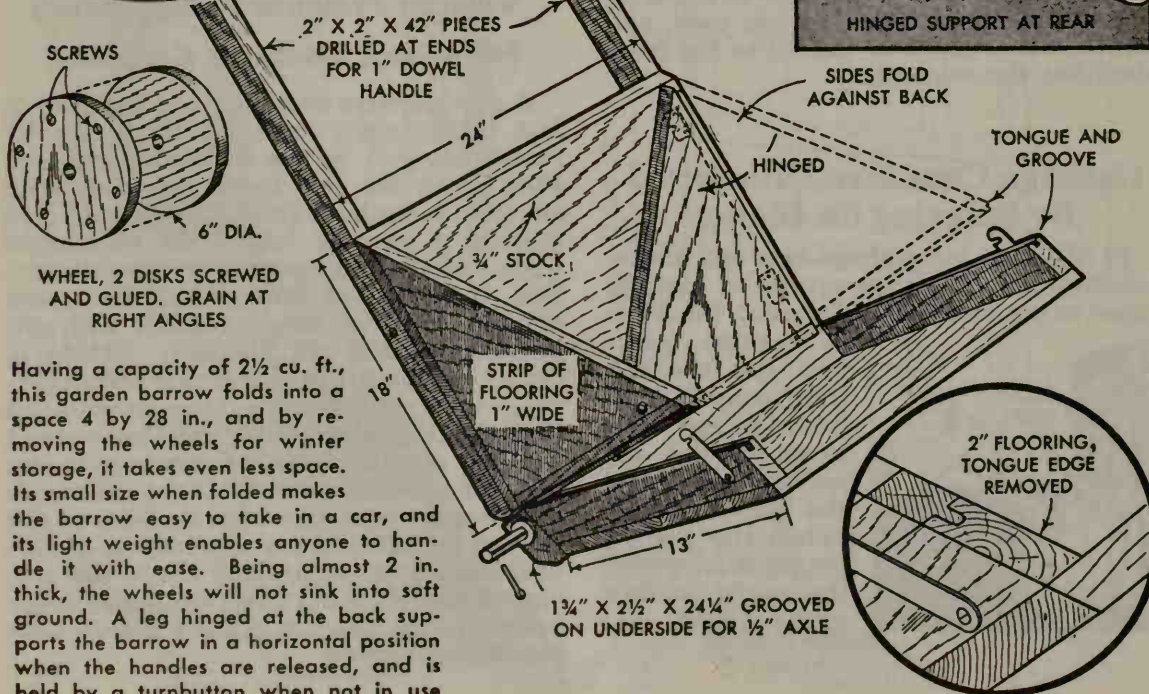
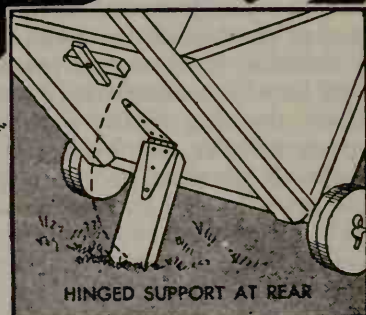
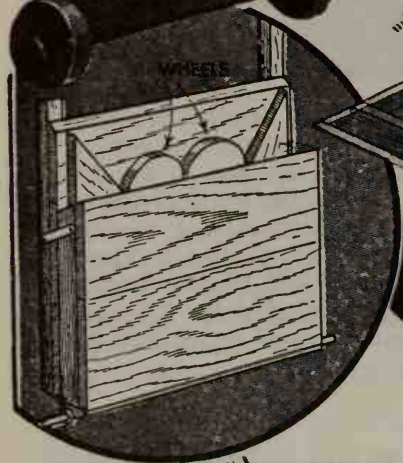


Having a number of articles to store and no available storage space, one car owner built a platform at the end of his garage just high enough for the hood of the car to fit under. A protective railing was bolted to the platform, and a stair ladder was placed at one side. With this arrangement, none of the space needed for the car was taken, but former waste space was put to use.

Vinegar Prevents Paint Flaking From New Garbage Container

A new garbage container can be made to last longer right from the beginning by rustproofing it in the following manner: First paint the can, inside and out, with common household vinegar. This mild acid coating is used to "etch" the galvanized metal and thereby roughen the smooth surface. If this is not done, subsequent coats of paint will not bond properly and will eventually flake off. Similarly, flaking is quite common in the case of new house gutters which are painted as soon as installed without first being etched. Roofing cement that has an asphalt base is superior to any paint as a preservative. Coat the entire can with cement and give both surfaces of the bottom an extra-heavy application. As an additional stunt to prolong life of the can, place a disk cut from wrapping paper in the bottom of the can and replace it each time the can is emptied.

GARDEN BARROW

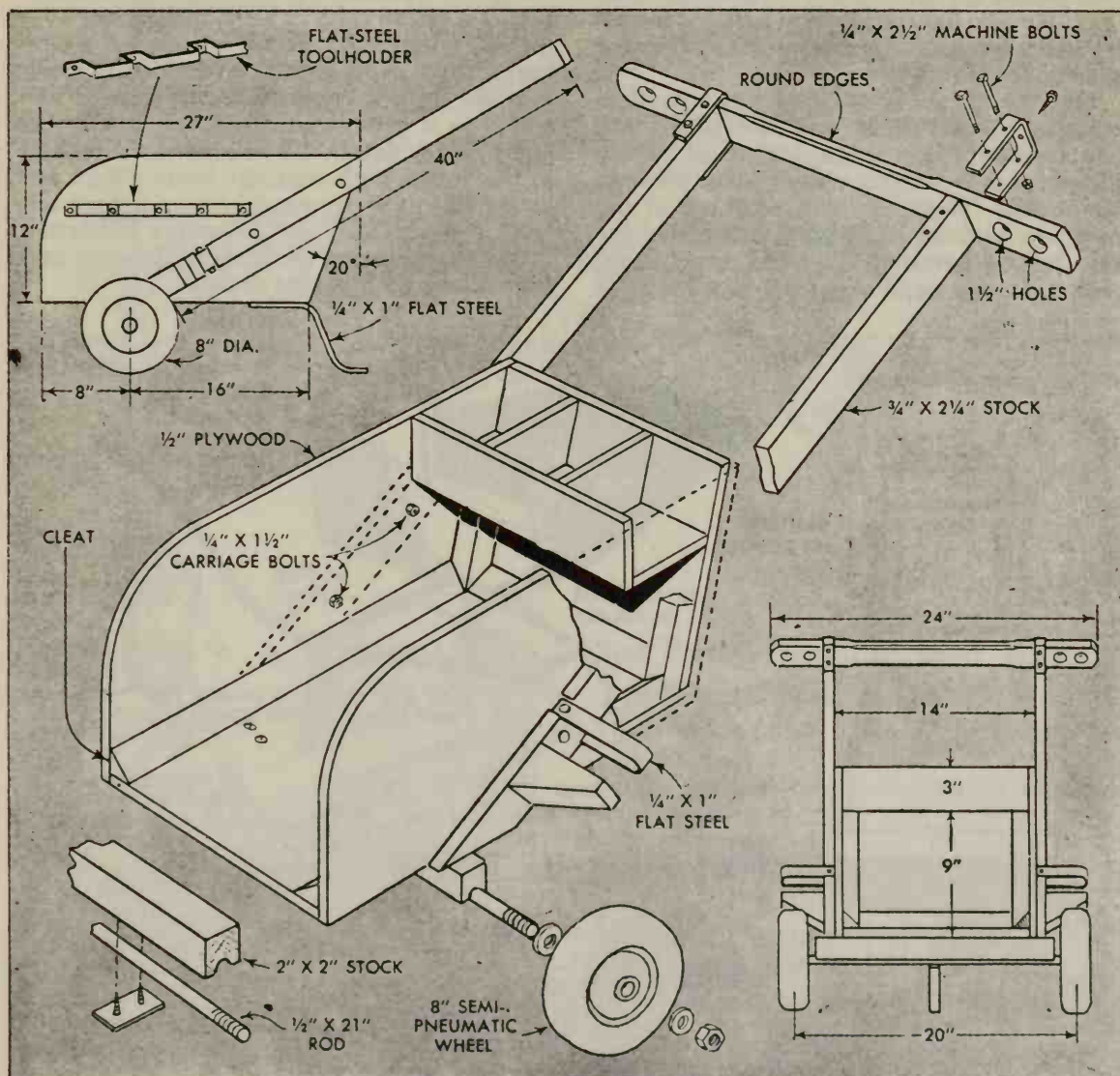


Having a capacity of $2\frac{1}{2}$ cu. ft., this garden barrow folds into a space 4 by 28 in., and by removing the wheels for winter storage, it takes even less space. Its small size when folded makes the barrow easy to take in a car, and its light weight enables anyone to handle it with ease. Being almost 2 in. thick, the wheels will not sink into soft ground. A leg hinged at the back supports the barrow in a horizontal position when the handles are released, and is held by a turnbutton when not in use.



GARDEN BARROW

THIS handy garden barrow will help eliminate the necessity of numerous trips back and forth from the garden to the garage to fetch various garden tools as the need for them arises. Wheeled along easily on two 8-in. semi-pneumatic tires, the barrow accommodates several long-handled tools, such as rakes and hoes, and has a convenient rack for carrying a number of small garden tools. The body, which contains compartments for seeds and bulbs, has plenty of room for carrying bags of fertilizer or grass seed, humus, plant clippings or hose. The body is constructed from $\frac{1}{2}$ -in. waterproof plywood. The axle is held in a groove cut in a 2 x 2-in. block attached to the underside of the barrow.



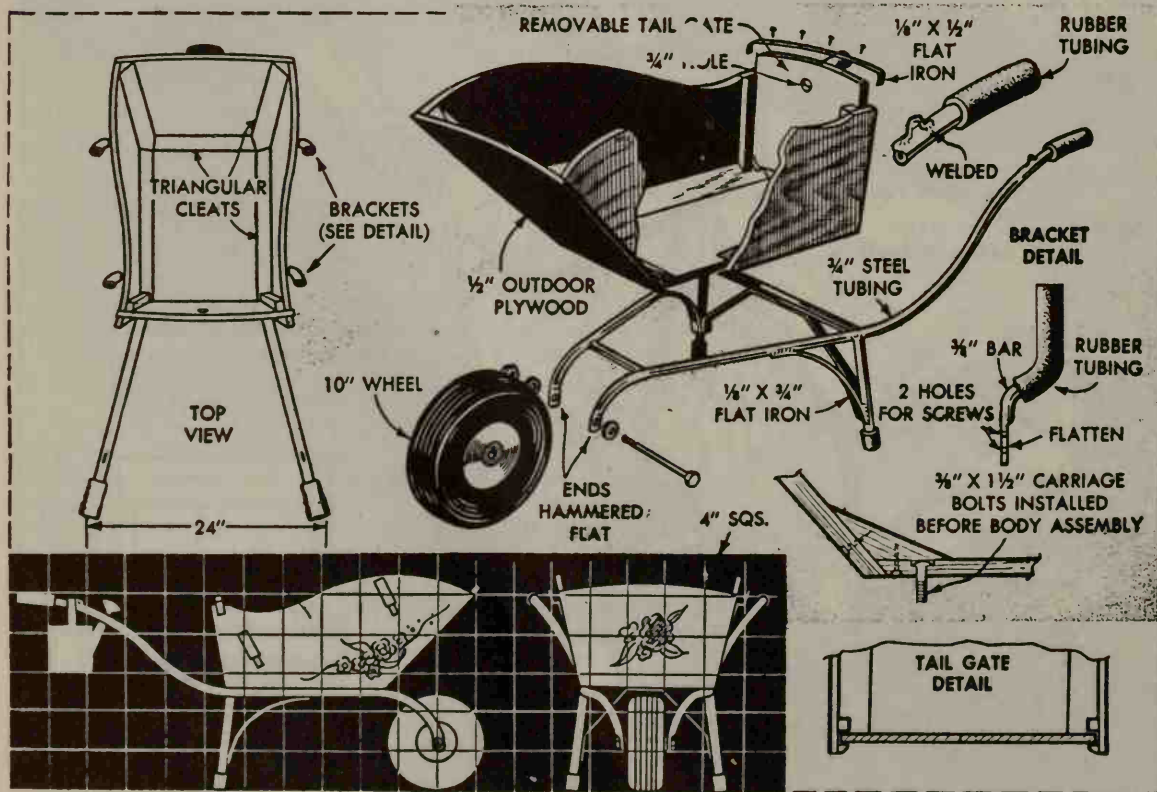
GARDEN BARROW

ESPECIALLY designed for the housewife who enjoys spending her leisure hours puttering in the garden, this lightweight wheelbarrow is exceptionally easy to handle. The frame is sturdily constructed of seamless steel tubing and is fitted with a 10-in. ball-bearing wheel of the semipneumatic type. Rubber-sheathed brackets for carrying a rake and hoe or spade are mounted on the sides of the body, and lips welded to the tubing near the handles provide hooks for sprinkling cans or baskets. Comfortable handgrips are had by pressing short lengths of rubber tubing over the ends of the handles.

The frame is of welded construction, utilizing $\frac{3}{4}$ -in. tubing, and each of the two side members is a single length of tubing which runs from the wheel yoke back to the handle. The ends of the tubing at the yoke are hammered flat and drilled for the axle before bending. To bend the tubing, pack with dry sand and heat in a forge or

with a blowtorch. Then bend the heated tubing around a wooden form.

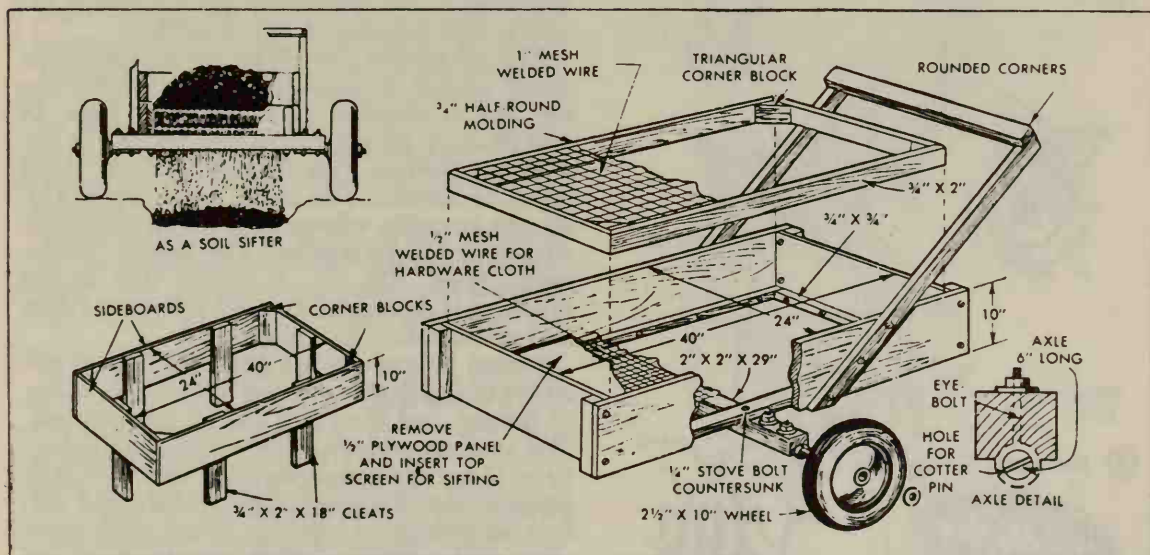
The body of the wheelbarrow is made of $\frac{1}{2}$ -in. outdoor plywood and is assembled by fastening the front, sides and bottom to triangular-shaped cleats with glue and screws. Note that the rear of the body is fitted with a removable tail gate which slides in a groove as shown in the lower right-hand detail. The body is attached to the frame with carriage bolts which are installed in the plywood bottom before the body is assembled. An attractive finish can be had by painting the body and frame and decorating with bright decals.



GARDEN CART

doubles as soil sifter

Gardeners will appreciate the simple construction and labor-saving features of this dual-purpose cart, which serves as a sifter as well as a cart. The box is fitted with a permanent bottom of $\frac{1}{2}$ -in. wire mesh over which a plywood panel is placed when hauling garden tools, fertilizer, leaves, loose soil or other materials. Remove the plywood bottom, replace it with a frame covered with 1-in. wire mesh and you have an efficient soil sifter. If desired, sideboards can be added for extra capacity. All surfaces should be covered with two coats of spar varnish to prolong the life of the cart.



Pipe Forms Shallow Seed Trench in Garden Beds

To overcome trouble in making shallow seed trenches straight and at a uniform depth in your garden beds, try a length of pipe. In most cases, the weight of the pipe will cause it to sink into a well-prepared soil deep enough for the trench. If necessary, a little pressure on the pipe will do the trick.

GARDEN INSECT CONTROL

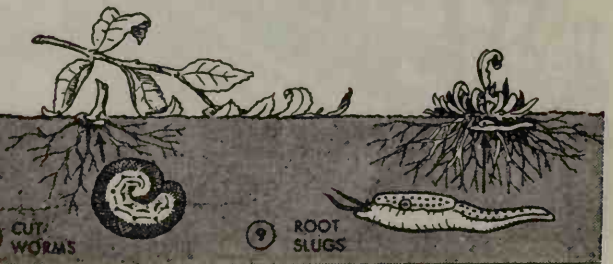
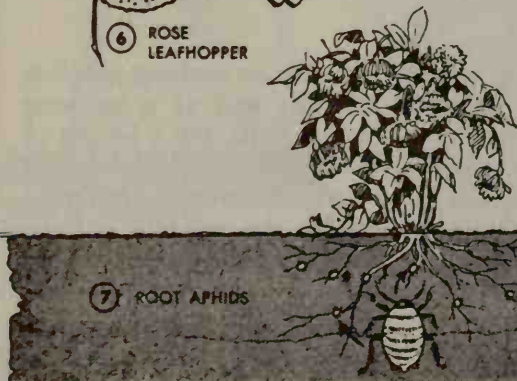
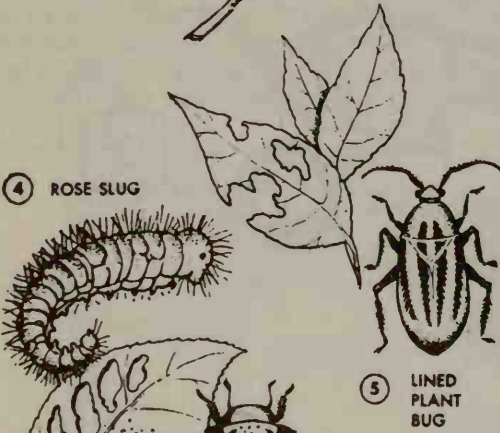
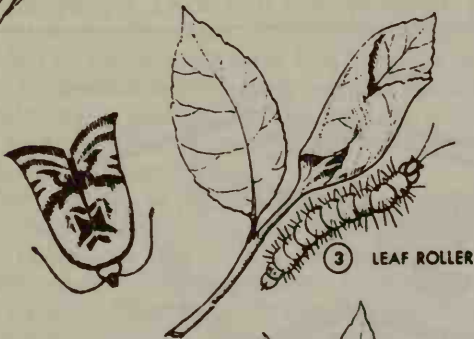
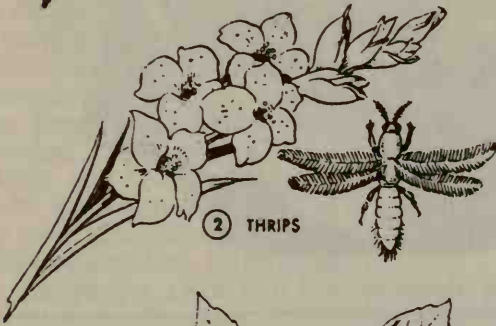
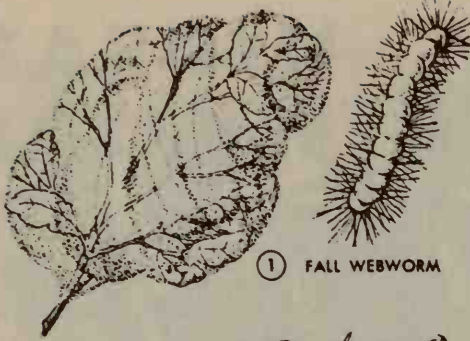
IF YOU SUDDENLY find your seedlings, transplants or carefully nurtured perennials wilting, drooping or dying despite all the approved cultural methods you've practiced, the trouble is likely to be bugs. Worst of all, you don't always know just when or where the pests are going to strike. That's why it's a good idea to keep a "loaded" sprayer or duster handy, just in case.

For the vegetable garden, one of the most efficient insecticides at present is that containing rotenone and pyrethrum in combination. Used either as a spray or dust, it kills the common sucking and chewing insects and is relatively nonpoisonous. In a general way, dusting is as effective as spraying in the vegetable garden and it requires less expensive equipment.

Fig. 19 shows the three positions of the spray nozzle necessary to cover both the top and underside of the leaves. Figs. 18 and 29 show sprayers suitable for use in the average garden. Figs. 30 and 31 show three types of dusters. The small hand types, Fig. 30, are suitable where only a few plants or shrubs are to be treated. The larger "knapsack" type, Fig. 31, is better for larger areas, as it delivers a greater volume of dust and gives better coverage.

Listed below are the principal insect enemies of the garden. There are many others, of course, but they are not so bothersome. The recommendations given for the proportions of sprays and dusts to be used are only general. As the proportion to be used differs according to locality, check with your state agricultural station for the best use of insecticides in your area. Where manufacturer's directions differ from those given below, follow the maker's recommendations in every case.

Fall webworm, Fig. 1: Ties a silken web around leaf clusters on which the worms feed. Attacks shrubs, fruit and shade trees. Control measures: (1) cut off and burn webs, destroying every worm; (2) spray foliage with lead arsenate at intervals, a general recommendation for the solution being 1 to 3 level tablespoonfuls to a gallon



of water. Garden and parsnip webworms are less destructive and can be controlled by dusting with calcium arsenate.

Thrips, Fig. 2: Minute fly-like insects, less than $\frac{1}{8}$ in. long. Larvae of gladiolus thrips winter on the corms. Store corms in sealed paper bags containing naphthalene flakes, 1 oz. of flakes to 100 corms. During the growing season spray foliage with a 1 to 200 dilution of pyrethrum or with a solution of Paris green, 1 rounded tablespoon, brown sugar, 2 lbs., and water, 3 gals.

Leaf roller, Fig. 3: Three common varieties—oblique-banded fruit-tree roller, red-banded roller and strawberry-leaf roller. Watch for them on fruit trees and strawberry plants and spray early with lead arsenate to catch worms at the first infestation.

Rose slug, Fig. 4: Larvae of rose sawflies. Slugs skeletonize leaves as shown. Control with a dust composed of fine dusting sulphur, 9 parts, and arsenate of lead, 1 part; a 3-in-1 copper spray, or nicotine sulphate, 1 teaspoonful to 1 gal. water and 1 oz. soap.

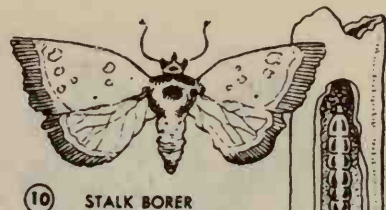
Lined plant bug or squash beetle, Fig. 5: Active, destructive pest which attacks common flowers. Also skeletonizes leaves of squash, cucumber and melon vines. Cover the vines and leaves with dust containing rotenone.

Rose leafhopper, Fig. 6: A tiny sucking insect attacking nearly all varieties of roses. Spray with nicotine sulphate and soap in proportions given for rose slug, or use spray containing pyrethrum.

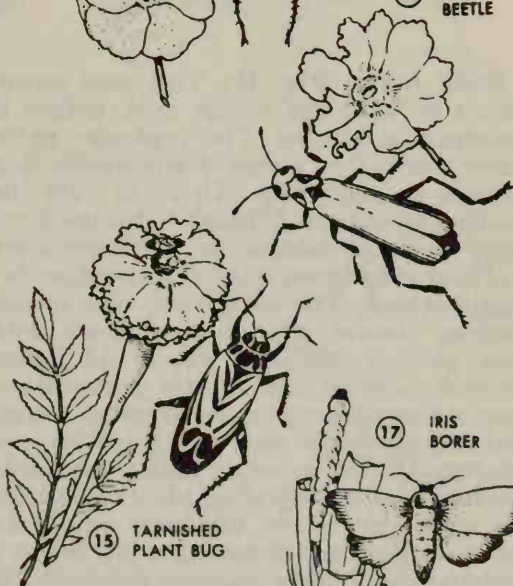
Root aphid or root louse, Fig. 7: Attacks roots of asters principally. Mix wood ashes with soil when setting out seedlings. Pour nicotine-sulphate solution or carbon bisulphide around base of plants, covering root area. Keep in mind that carbon bisulphide is inflammable, and do not inhale the fumes.

Cutworm, Fig. 8: Lops off tender seedlings at ground level. Scatter mixture of white arsenic, 1 oz., dry bran, 1 lb., and molasses, 2 tablespoonfuls in 1 qt. water. To protect birds place the bait under wide boards laid in line and close to the plants.

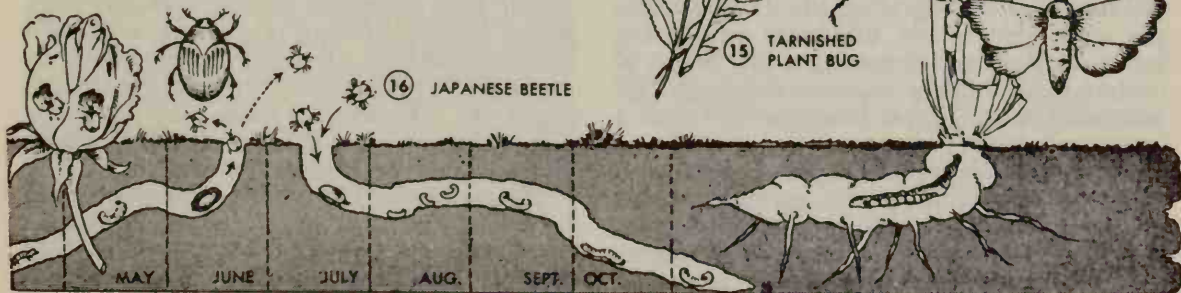
Root slug, Fig. 9: Bothers young delphiniums. Spread air-slaked lime, tobacco dust, soot or wood ashes around the plants. Mix lightly into the topsoil. Dust slices of raw potato with Paris green and place near plants.

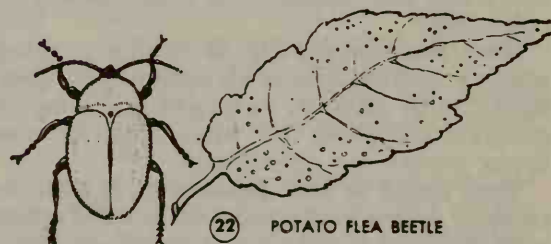
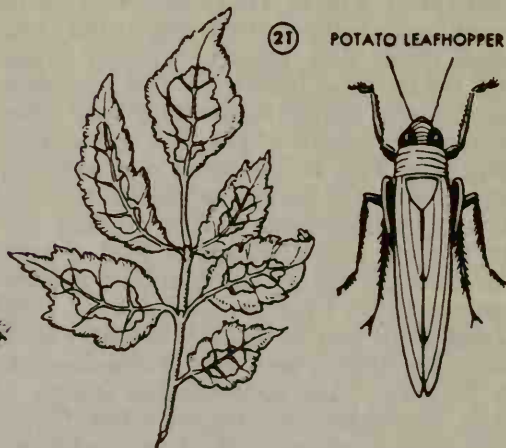
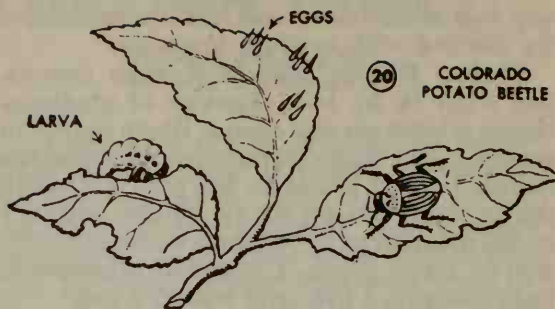
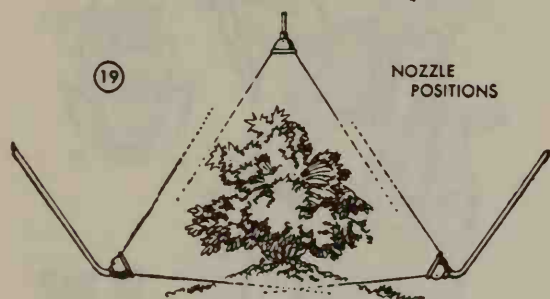


14 BLISTER BEETLE



16 JAPANESE BEETLE





Stalk borer, Fig. 10: This pest causes plants to wilt and topple over before its presence is known. The common native borer works into stems of any plants large enough to shelter it. There is only one yearly generation of "hatch." But the European borer, or corn borer, produces a second and sometimes a third generation in a single season. The corn borer also attacks dahlias, zinnias, garden sunflowers, potatoes, gladioli and other plants. At present control methods are mostly preventive—burning or plowing under infested growth and any stalks or trash in which the pest winters. During growing season the borers can be killed in individual plants by slitting the stalk just above the point where the borer entered and injecting a few drops of carbon bisulphide or nicotine sulphate. Tall plants so treated must be supported with a stake or by other means.

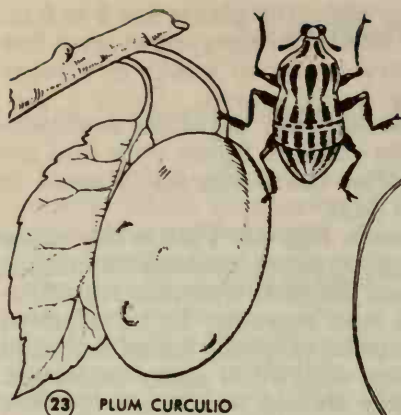
Bagworm, Fig. 11: Destructive shrub and shade-tree pest in certain sections of the United States, and a special enemy of evergreens. Gather and burn the conspicuous "bags" and spray infested growth with lead

arsenate during spring and summer months when larvae appear.

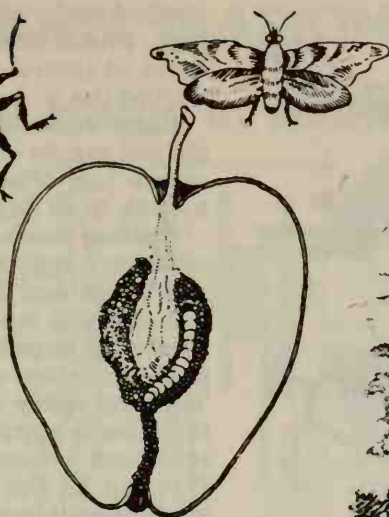
Aphid, or plant louse, Fig. 12: Aphids attack almost any garden or greenhouse crop. Heavy infestations are serious, as the lice are carriers for many plant diseases. Pyrethrum-rotenone compounds used as spray or dust and nicotine sulphate-and-soap sprays are effective on practically all growth.

Red spider, Fig. 13: This is not really a spider but a tiny mite weaving almost invisible spiderlike webs on the underside of leaves of vegetables, ornamental plants and evergreens. Hosing evergreens with water under high pressure discourages the pest, but a better method is dusting with fine dusting sulphur, covering the growth thoroughly. Pyrethrum-rotenone sprays or dusts are effective on other plant growth, but the spray or dust must hit the undersides of the leaves as well as the tops.

Blister beetle, Fig. 14: Slim-bodied, lively beetles about $\frac{3}{4}$ in. long. Voracious feeders on foliage of vegetable, flower and field plants, Spray foliage with lead-arsenate



(23) PLUM CURCULIO



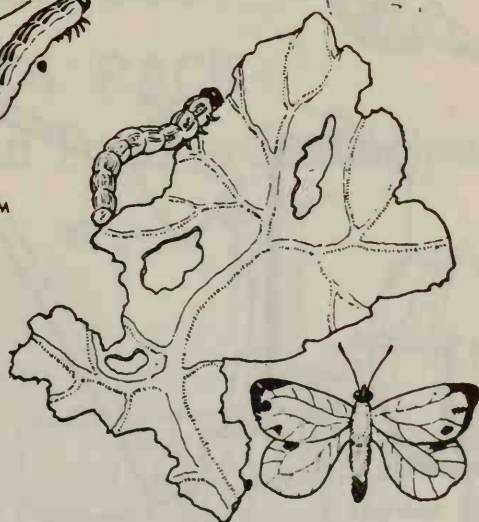
(24) CODLING MOTH



(25) PEAR SLUG



(26) CORN EAR WORM



(27) CABBAGE WORM

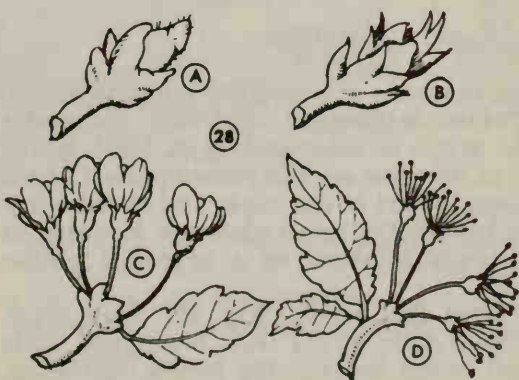
solution. Where flowers are infested, knock the beetles out of the blooms into a pan containing kerosene.

Tarnished plant bug, Fig. 15: An active, brown-mottled bug about $\frac{1}{4}$ in. long. Feeding habits cause wilting and blackening of leaves and twigs. Difficult to control ordinarily, but pyrethrum sprays or dusts generally are sufficiently effective to permit near-normal growth of most plants.

Japanese beetle, Fig. 16: A serious, spreading pest, against which soils can be inoculated with spores of a disease fatal to its larvae. Dry lime applied thickly to foliage is an effective repellent of the adult beetles. Valuable sod can be protected from ravages of the larvae by spreading 5 to 7 lbs. of lead arsenate over each 1000 sq. ft.

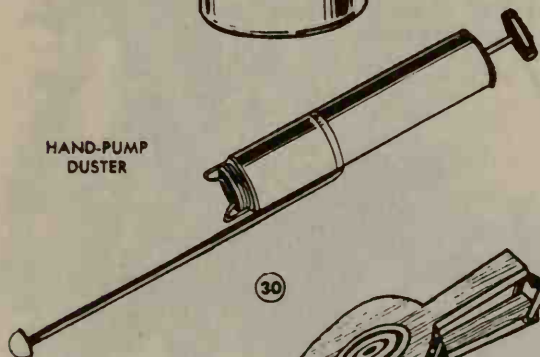
Iris borer, Fig. 17: Before growth starts cover beds with straw or dry trash and burn to destroy the eggs. Always keep the fire hazard in mind when burning beds. Spray new growth with arsenate of lead.

Colorado potato beetle, Fig. 20: Most common insect damaging potatoes. Spray or dust foliage with arsenate of lead, cal-

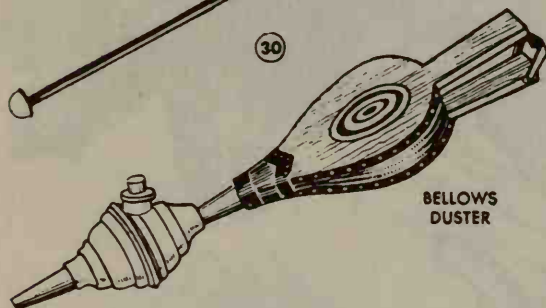




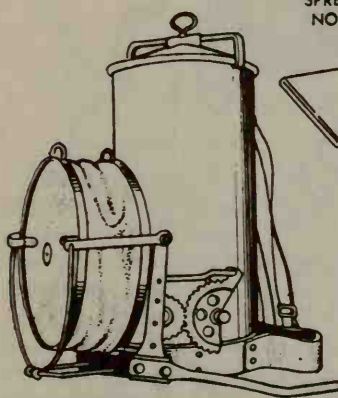
HAND-PUMP
DUSTER



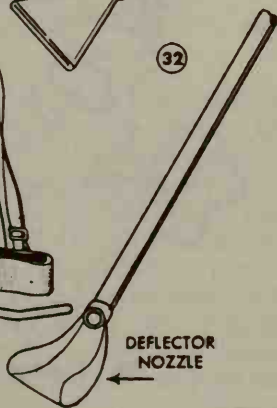
BELLOWS
DUSTER



SPREADER
NOZZLE



KNAPSACK
DUSTER



DEFLECTOR
NOZZLE

cium arsenate or any other potato spray.

Potato leafhopper, Fig. 21: Generally light green in color and $\frac{1}{8}$ in. long, this is one of the most serious potato pests. Causes foliage to curl at the edges and become dry and brittle. On small plots use a prepared Bordeaux mixture or a prepared potato spray.

Potato flea beetle, Fig. 22: Tiny black beetle a little larger than a pinhead. Eats small round holes in the leaves. Bordeaux mixture is a good repellent, but must be

applied early when the plants are 3 to 6 in. high. Plants should be sprayed at least five times at intervals of two weeks or oftener during the growing season.

Plum curculio, Fig. 23: Cuts crescent-shaped marks on fruit. Spray with lead arsenate just after the petals fall. Repeat in a week to 10 days.

Codling moth, Fig. 24: This is the cause of wormy apples, pears, crabapples, quince and black and English walnuts. An effective spray is lead arsenate. To be effective this spray must be carefully timed and used in combination with other spray materials. The first spray should be given when the fruit buds appear as at A in Fig. 28 and must end before the leaves are $\frac{1}{4}$ in. long, B in Fig. 28. For this spray mix concentrated lime-sulphur, 1 gal. and nicotine sulphate, 5 tablespoonfuls, 40 percent solution, in 10 gals. water. For the "pink-bud spray," C in Fig. 28, use lime-sulphur, 1 qt., and lead arsenate, $1\frac{1}{4}$ cups, in 10 gals. water. For the petal fall, or calyx spray, use lime-sulphur, $1\frac{1}{2}$ pints and lead arsenate, $1\frac{1}{4}$ cups. Repeat calyx spray after 10 days and again 3 to 4 weeks after petals fall.

Pear slug, Fig. 25: Spray with nicotine sulphate or arsenate of lead, making sure that spray covers both sides of leaves.

Corn ear worm, Fig. 26: Attacks when ears are in the silk. Dust silks with a mixture of hydrated lime, 1 part, to lead arsenate, 2 parts, beginning when the silks first show and continuing at intervals. Or use corn ear worm insecticide when the silks start to turn brown.

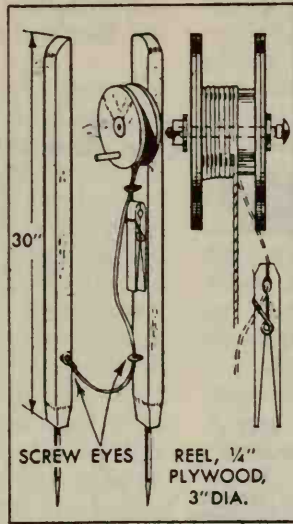
Cabbage worm, Fig. 27: Riddles the first leaves of cabbage and cauliflower and later attacks outer leaves of formed cabbage heads. Use a combination pyrethrum-rotene dust. In heavy infestations, keep the growth covered at all times.

Garden-insect pests are generally of two kinds—sucking and chewing, the terms referring to the manner of feeding. The damage caused by common chewers shows up quickly and usually the offenders are discovered easily and put out of business. But certain of the sucking insects work less openly and are so tiny that they are not discovered by a casual examination. Moreover, they can generally be destroyed only by bringing the sprays or dusts in contact with their bodies. Against certain other spreading pests only preventive methods are used at present, although these insects will probably be brought under a measure of control by newly developed sprays and dusts now used experimentally. Of course, manufacturers do not market these new products until they know what they will do, hence most of the old stand-by sprays and dusts still are recommended. And many of these are being improved.

GARDEN MARKING-REEL

No-Stoop Reel Helps in Marking Garden Rows

This stake-and-reel assembly, which eliminates much stooping and kneeling when marking garden rows, is easy on your back and leg muscles. The stakes are $\frac{3}{4}$ x $1\frac{1}{2}$ x 30-in. stock and are drilled to take $\frac{1}{4}$ -in. steel rods. The sharpened ends of these rods project about 5 in. from the bottoms of the stakes. The reel consists of two 3-in. disks cut from $\frac{1}{4}$ -in. plywood and glued to a short section of 1-in. dowel, which acts as a hub. The handle of the reel is a dowel glued in a hole in the outer disk. A spring-type clothespin is mounted on the stake just below the reel. In use, a second stake is pushed into the ground, and the reel stake is carried to the other end of the

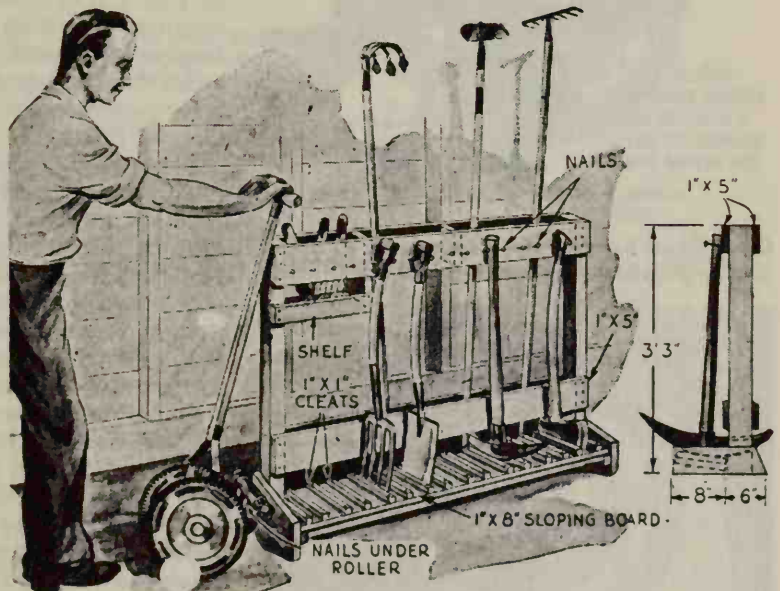


garden row, unreeling as you go. The cord is drawn tight and clamped in the clothespin after the reel stake has been pushed into the ground.

GARDEN TOOL RACK

Handy Rack Stores Garden Tools in Small Space

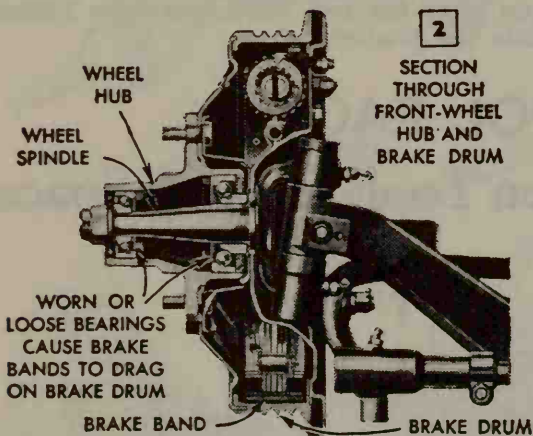
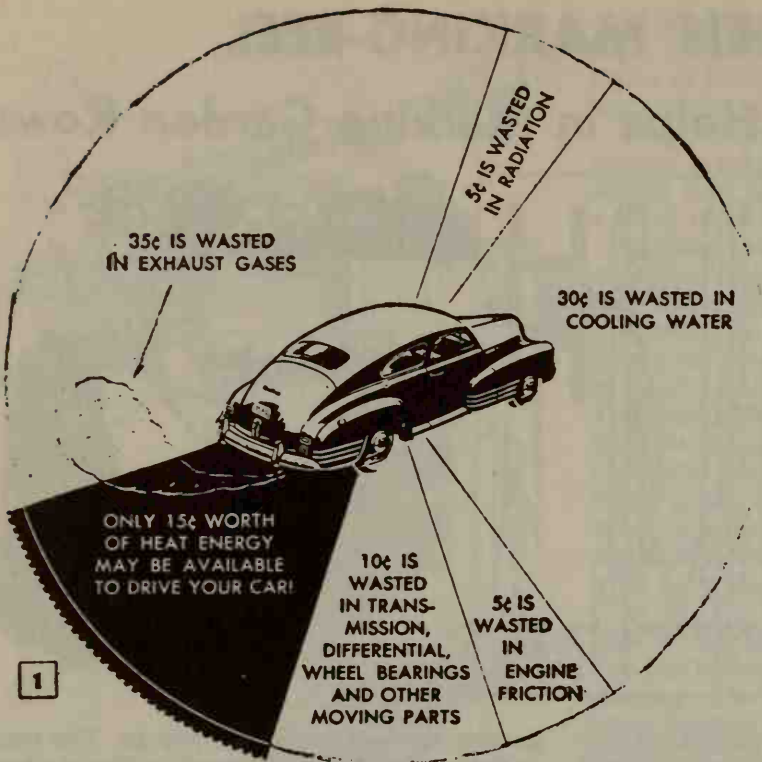
Assembled from scrap lumber, this handy rack is just the thing for gardeners who have limited space in which to store their tools. While dimensions can be varied to accommodate more tools, distance from the sloping base to the large nails on which the handles rest should not be greater than the length of the shortest tool handle. Also, space should be provided between the base and lower crosspieces to insert picks and similar tools. Long-handled tools, such as rakes, hoes, cultivators, etc., stand upright between the upper and lower crosspieces. A shelf is provided at one of the upper corners in which trowels and other small tools can be stored. Even the lawn mower can be accommodated by driving two large nails or L-hooks into the end of the rack near the bottom. These are



spaced so that when the wooden roller of the mower is hooked over them the handle will be in upright position. The rack requires only a small space in the garage or tool shed.

GASOLINE MILEAGE

The miles per gallon of fuel your car delivers depends not only on your driving habits, but more on how well you keep all parts of the car adjusted. That is why it is important to keep the ignition and fuel systems at peak operating efficiency, and to check the brakes, lubrication and wheel alignment to reduce rolling resistance to the minimum



Loose wheel bearings can be the cause of dragging brakes. Brake shoe contacts bottom of drum



DO YOU KNOW that only 15 cents' worth of gasoline out of every dollar spent for car fuel actually reaches the wheels in the form of power to propel the car? The remaining part of your dollar's worth of fuel is expended in friction, exhaust gases, heat radiation and cooling water. A careful study of the diagram in Fig. 1 will show how important it is to fuel economy to keep all parts of the car adjusted to give peak performance.

In this two-part story, C. Edward Packer, a former Service Instructor of the Ford Motor Co., will describe numerous ways the motorist can conserve gasoline by simply keeping the ignition and fuel systems adjusted correctly, and by keeping a careful check on brakes, lubrication, wheel alignment and other friction-producing parts of the car.

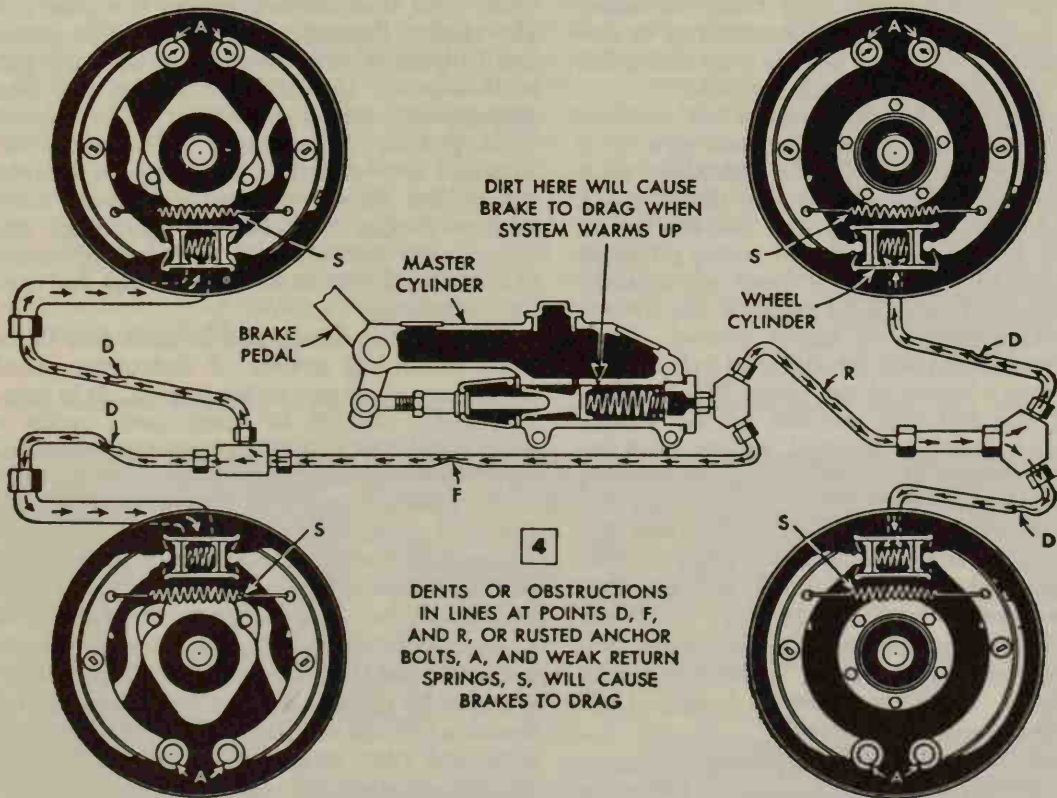
Normally, about 10 percent of the engine's power is consumed in the train of power-transmitting parts. Any condition which tends to increase frictional drag in any of the parts will increase the power loss proportionally. Also, a tight or loose wheel bearing, a dented hydraulic-brake line, worn brake-shoe pivots and wheel misalignment, even though slight, can cut gasoline mileage appreciably. If a wheel bearing is sufficiently loose, the bearing slack may cause the bottom brake shoe to drag on the lower part of the drum as in Fig. 2. A slight drag on all four wheels is not apparent in the operation of the car, but it can cut fuel mileage considerably. Bearings that are too tight may heat and develop sufficient drag to affect fuel economy. A flying stone thrown by the wheels or a carelessly handled jack can

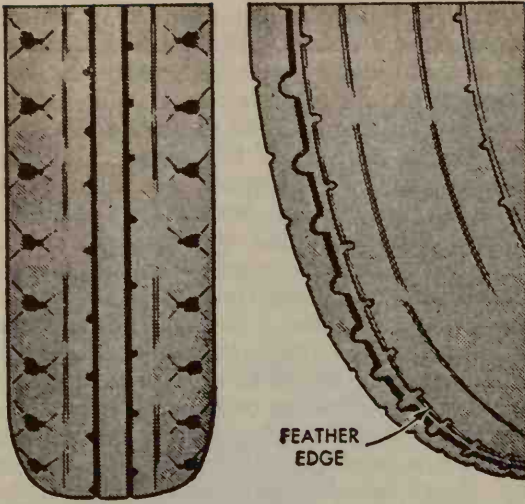
dent hydraulic-brake lines. Such a dent may prevent the brake shoes from releasing fully after application. A dent in any of the lines indicated by the letter D in Fig. 4 will affect only the brake connected to that particular line, but a dent at point F would act equally on both front brakes. Similarly, a dent in the line at R would act equally on both rear brakes.

In most cases, such dents only partially impede the flow of hydraulic fluid and do not noticeably interfere with application of the brakes. But when the pressure on the pedal is released, the tension of the brake-shoe retracting spring, Fig. 4, S, is not sufficient to immediately free the brake shoes completely from contact with the drum. The release is slow, due to the greatly restricted flow of the brake fluid. During this time, the car can be rolled by hand on the level only with great difficulty. Another condition in the brake system that cuts deeply into gasoline mileage is due to dirt clogging the bleeder hole in the master hydraulic cylinder, Fig. 4. With the brake in the released position, the rubber cup on the end of the master-cylinder brake piston uncovers this hole. Then, as the car is driven and expansion of the hydraulic

fluid takes place due to rising temperature, fluid moves out of the brake system and into the master-cylinder chamber above the piston. As the brakes are applied, this bleeder hole is covered as soon as the master piston moves. If the bleeder hole becomes partially clogged, all four brakes will drag on release, perhaps not enough to affect noticeably the performance of the car, but sufficient to cause a considerable loss of power. Similarly, rusted brake-shoe bolts or pivot pins, A in Fig. 4, can prevent the quick and free release of the shoes. Failure of the shoes to release also may be due to weak, broken or missing brake-shoe springs. If a car gives poor gas mileage, these are possible causes to keep in mind as they usually are overlooked when checking a car to improve mileage.

Front-wheel bearings should be washed and relubricated in the spring and fall, Fig. 3. Avoid packing the bearings with too much grease as they will be difficult to adjust correctly. When the bearing is reinstalled, the castle nut should be drawn up until the wheel begins to bind. Then the nut is backed off slowly until the wheel spins with only a very slight drag. If correctly made, this adjustment permits the





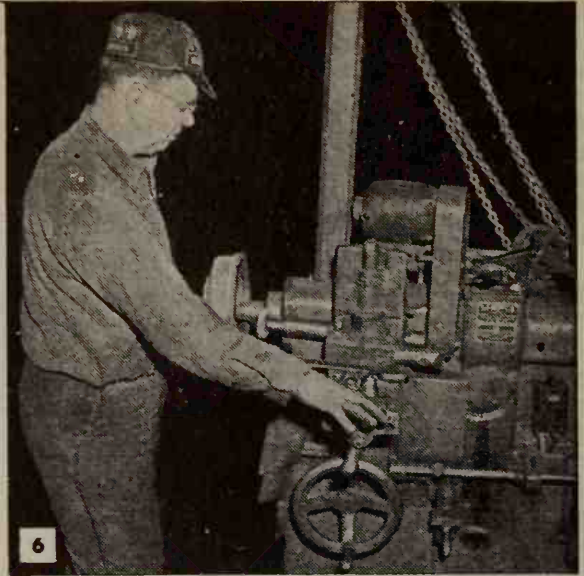
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Misalignment of the front wheels causes rapid tire wear. Abnormal road friction requires more power

wheel to run with no noticeable looseness. Rear wheels, if provided with adjustable bearings, should be set up for free running with no measurable looseness. If the bearings are of the straight roller type, any up-and-down play should be corrected by replacing worn parts. Where brakes are of the hydraulic type, care must be taken when brake drums are removed not to depress the brake pedal, as this may drive the wheel pistons out of their cylinders.

Condition of the tires will reveal certain mechanical faults to a practiced eye. For example, a flat spot at only one place on a tire usually indicates a brake drum worn out of round. This can mean that the brake shoe is riding the drum at some point at each turn of the wheel. Proper adjustment of the brakes cannot be made if the drums are out of round or badly scored. Most defective drums can be restored to full usefulness on a brake-drum lathe, Fig. 6. After truing the braking surface of the drum, the shoes must be relined, either with an oversize lining or regular lining applied over a suitable shim to compensate for the enlarged diameter of the drum. After the lining is securely riveted or cemented to the metal shoe, it is ground to the exact radius of the drum as in Fig. 7. When installing the repaired parts, renew the brake-shoe pivot pins and retracting springs if these parts are damaged or weakened by rust.

When feather edges develop along a front-tire tread as in Fig. 5, it indicates either too much toe-in or toe-out, depending on which side of the tire the excessive wear develops. The tire is not only rolling forward, but is being scuffed sideways as well. This takes a lot of power by adding



6

It's good economy to true up any defective brake drums; otherwise brakes cannot be properly adjusted

to the rolling resistance. Wheel alignment should be checked periodically to avoid fuel waste and excessive wear on the tires. Driving with the tires underinflated likewise results in lowered tire and fuel mileage. Soft tires make the car ride easier, but the added road friction consumes extra fuel. The tires flatten under the load and the undue flexing of the side walls eventually breaks down the fabric on each side of the tread. Underinflated tires also heat excessively when driven at high speeds. This greatly accelerates side-wall wear. The new low-pressure tires, designed to run on 24 lbs. of air pressure, present more square inches of tread to the road, and thus carry the load at reduced pressure. However, these tires should not be used underinflated.

Wheels that dance and bounce due to the poor snubbing action of defective shock absorbers consume extra power. It is comparatively simple to keep these parts in good condition at a minimum cost by regular inspection and servicing.

Incorrect lubricants can almost double the fuel energy required to deliver power through a transmission such as that shown in Fig. 10. Relatively the same losses from this cause can also occur in the rear axle. It is true economy on the part of the car owner to see that the chassis lubricants are adapted to the car and to the change in the seasons. When refilling both the transmission and rear axle with lubricant, follow the manufacturer's recommendations.

Check the clutch-pedal clearance. The pedal should have at least $\frac{3}{4}$ in. of free movement to assure full engagement. A simple check any driver can make, Fig. 9, will show quite accurately the condition of



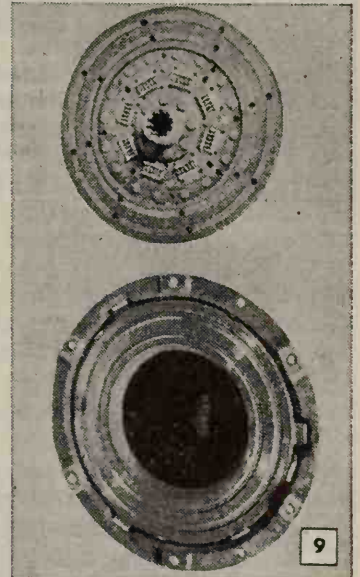
After relining, brake shoes should be ground down to the exact radius of the drum to prevent chatter



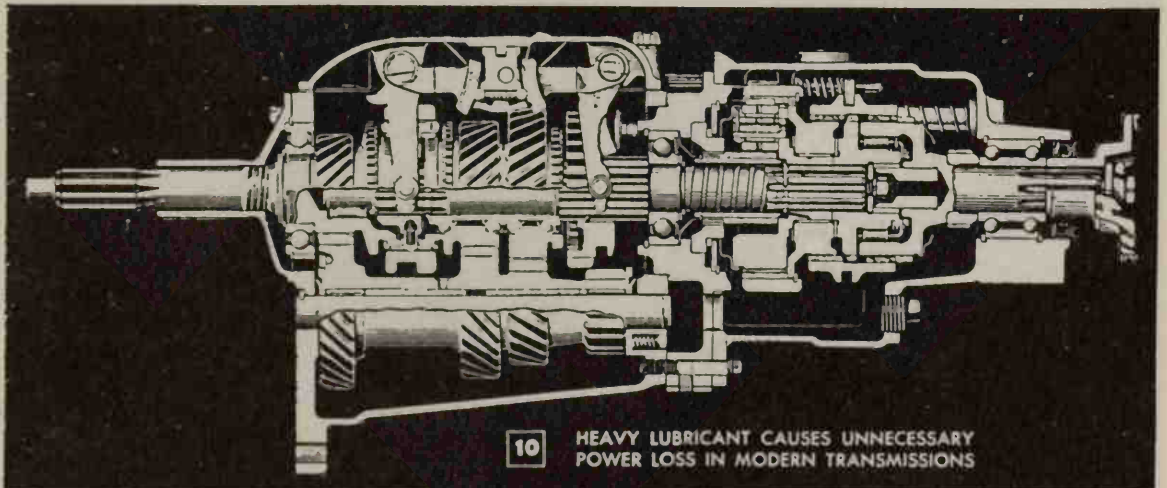
If the engine tends to overheat, clean the cooling system and solder any leaks that show under test

the clutch. Drive at 15 m.p.h. on a straight road in high gear and apply both the brake and the accelerator at the same time. Try to balance the pressure on brake and accelerator so that the car continues to run at 15 to 16 m.p.h. If, under this combined braking and acceleration, the engine suddenly breaks loose and races, it indicates that the clutch is slipping badly. If the clutch is in good condition, this procedure will kill the engine, even though the driver continues acceleration. A slipping clutch not only wastes gas, but it soon burns so that the facing has to be replaced.

If the engine temperature stays slightly above normal for any length of time, clean the cooling system. Use a good commercial cleaner and, if the car has been in use two or more years, have the radiator back-flushed after the cleaner has been removed. If this is not done, loosened particles of lime and rust may clog the small water passages in the radiator. Small leaks sometimes show up in a radiator after cleaning and should be closed by soldering as in Fig. 8. A leaky radiator may cause overheating and waste expensive antifreeze solutions.



Below, improper lubricants in the transmission and, center, a slipping clutch can cause high power losses



HEAVY LUBRICANT CAUSES UNNECESSARY POWER LOSS IN MODERN TRANSMISSIONS



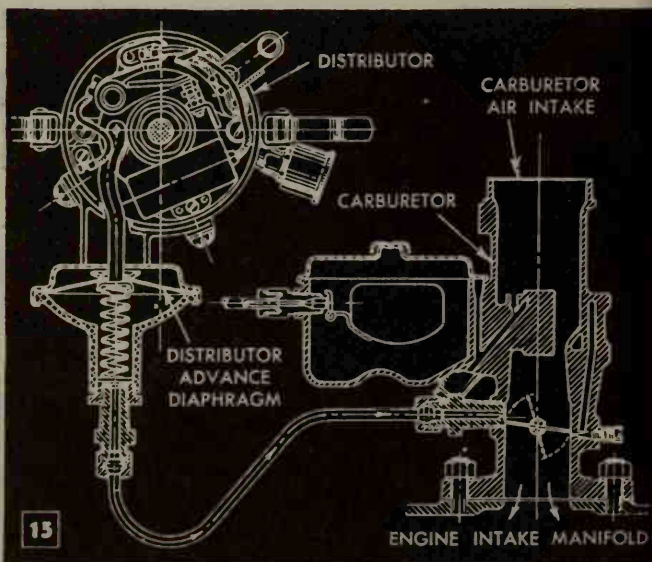
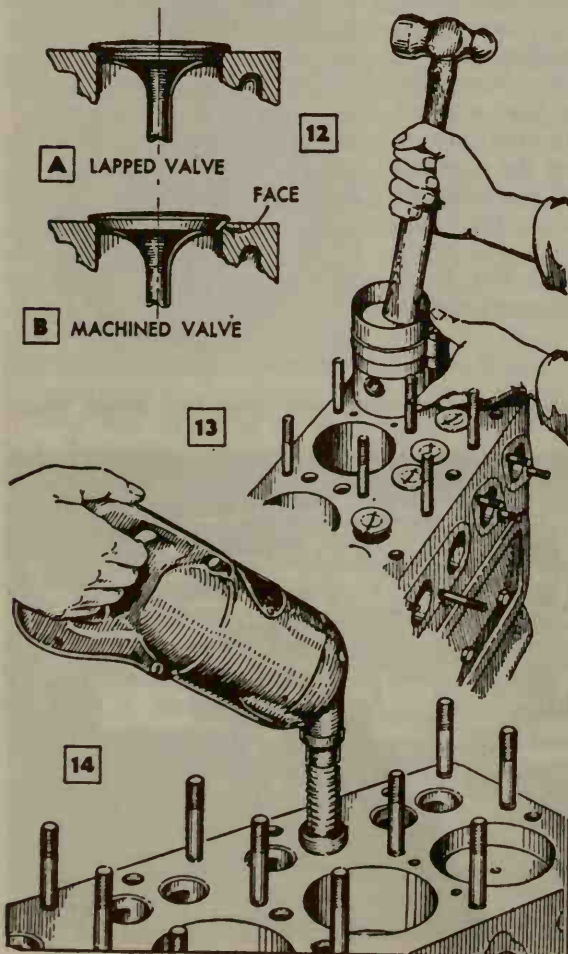
Checking cylinder for taper and out-of-round with a dial gauge to determine type of rings to use for repairing

Four major parts of your car require careful periodic checks if you are to get top performance and best possible fuel economy

IN MAKING your car-fuel dollar go as far as possible, it isn't enough to check brakes, wheel alignment and lubrication as described in Part I. To get high operating efficiency and economy from your car, it is necessary that the service and repair schedule include the engine and the ignition, fuel and cooling systems. Servicing and repairing only one or two units and neglecting others that may need attention is not likely to make any noticeable difference in either performance or economy. It's the regular servicing of all units of the power plant that pays off in the long run.

The engine cannot operate efficiently unless it quickly warms to normal operating temperature after starting. Ordinarily, this should range from 160 to 180 deg. F. If the temperature ranges below 160 deg. F., the thermostat should be adjusted. If it runs above 180 deg. F., the cooling system likely needs a thorough check. The carburetor heater valve, generally located in the exhaust manifold, warms the fuel-and-air mixture coming from the carburetor. When the engine is cold, a maximum amount of exhaust heat is deflected to warm the incoming fuel. As the engine warms up, the bimetallic spring, one end of which rests on the anchor pin and the other in the valve shaft, causes the valve to open.

Check this mechanism often to make certain it is working properly. The com-



GASOLINE MILEAGE

pression of all cylinders should be tested regularly and recorded. Cylinders with pressure noticeably above average no doubt are badly carboned and any that are 10 lbs. below the average pressure may have scored walls, worn rings or bad valves. Such conditions call for the removal of the head. Careful mechanics start engine overhaul with an instrument check of cylinder condition, Fig. 11. The dial gauge shows at a glance how much each cylinder bore is out of round and also records the degree of taper. If taper exceeds .015 in., most mechanics will recommend a complete reboring job. When putting in special oil rings, breakage will be prevented by removing the ridge at the top of the cylinder bore before the pistons are pulled. And, of course, a ring compressor, Fig. 13, is used when installing pistons fitted with new rings. While the engine is open, the water jackets should be flushed out.

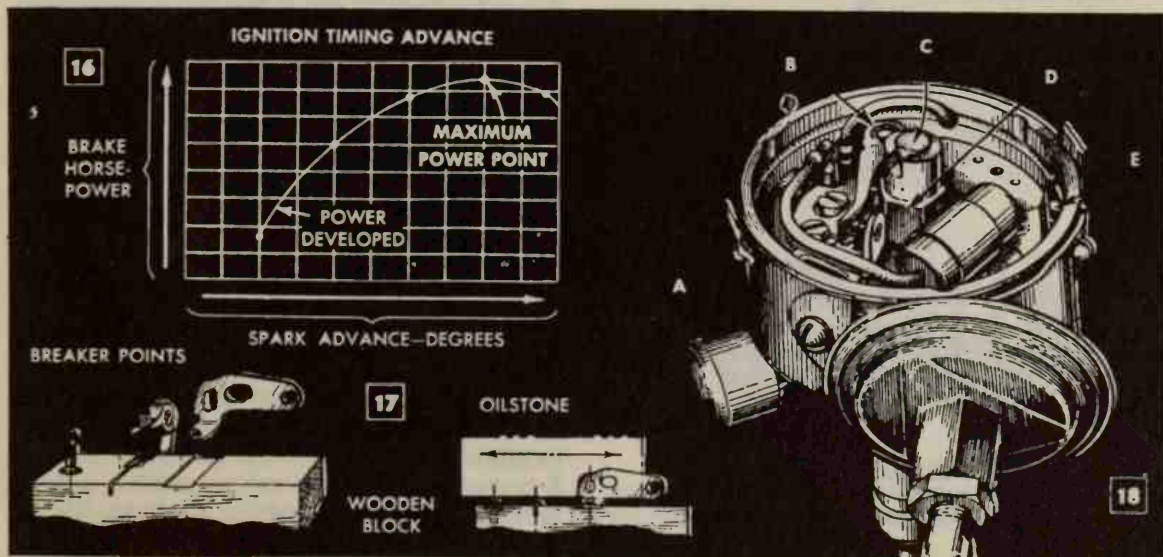
Having the valves refaced and resealed, Fig. 14, usually results in greatly improved gasoline mileage. Fig. 12, detail A, shows a valve with a groove worn in the face. If such a valve is "lapped in" with the engine cold, it may not seat properly when engine temperature rises. The valve face should be machined as in Fig. 12, detail B, and the seat in the block renewed by grinding.

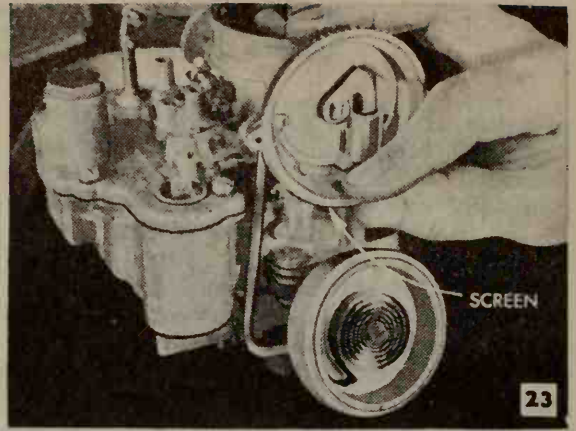
A worn timing chain causes what mechanics call "valve lag"; that is, the intake valve opens after the piston passes top dead center on the intake stroke. This creates a partial vacuum inside the cylinder that tends to pull oil past the piston. Many stubborn cases of oil pumping are traceable to a worn timing chain.

With the engine in good mechanical

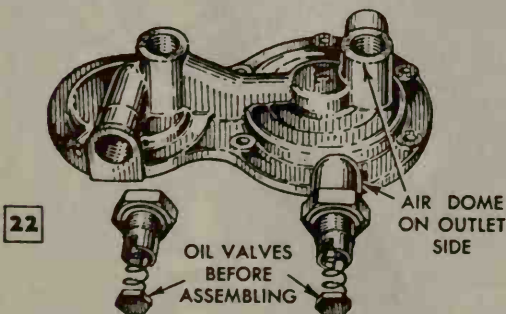
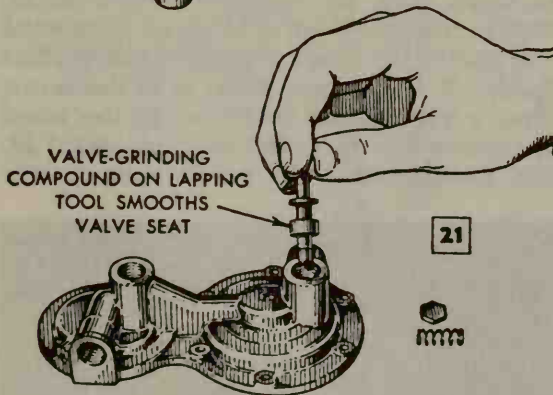
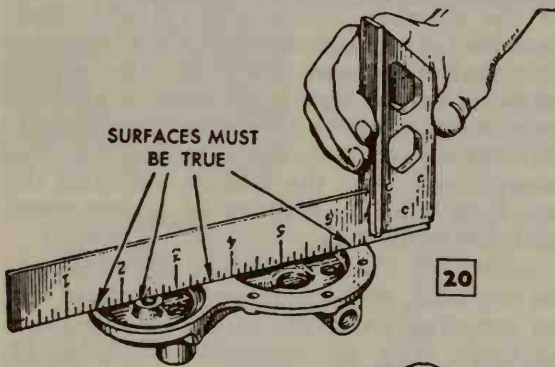
shape, the ignition generally is rated next in importance in a thorough tune-up. If a spark plug "oils up," it often means that it is running cold. Install plugs of the correct heat range. Sometimes the high-tension wire to the oily plug is in bad condition or making poor contact. Replacing the wire often cures the trouble. If the inside of the distributor cap shows evidence of arcing and is dirty or cracked, it will pay to install a new one. On some distributors there are five places, Fig. 18, that need lubricating at regular intervals. The grease cup, A, should be turned down regularly. Also, place a drop of oil at B every 1000 miles. An occasional smear of grease applied to the breaker cam, D, will prolong the life of the fiber bushing. At 5000-mile intervals, a drop of oil applied with a toothpick at C is desirable. And, at the same time, a drop of oil on the ball bearings of the advance mechanism, E, is recommended. A typical vacuum spark-advance mechanism is shown in Fig. 15. The importance of proper spark advance in efficient engine operation is illustrated by the ignition timing-advance curve in Fig. 16. The straight arrow at the bottom indicates the spark advance in degrees as engine speed and power increase.

Although burned breaker points should be replaced, those only slightly pitted can be removed from the distributor and re-surfaced with an oilstone as in Fig. 17. Mount the points on a block of hardwood and groove the block to support the bracket firmly. If the ground point is of the screw type, a hole should be drilled in the wood to receive the threaded end in a tight fit. The distance that the points open in any





Above, checking screen in choke-control heater. Left, testing fuel pump. It should lift fuel 30 in.



particular distributor determines the cam angle. If there is any doubt about the correctness of the cam angle, have the mechanism checked on a precision tester.

Complete service kits for most fuel pumps and carburetors can be purchased from auto-supply dealers. When overhauling either of these units, lay the parts out in order on a tray. Then the new parts from the repair kit can be substituted for the old ones as the unit is rebuilt. In servicing the fuel pump, a very important check is made with a straightedge to see that the joining surfaces of the housing are true, Fig. 20. If only slightly distorted, they may be made serviceable by rubbing them on a sheet of coarse emery cloth.

Fuel-pump service kits include diaphragms, and these should be soaked in kerosene before assembling. See that the holes are correctly lined up and held in alignment while tightening the diaphragm nut. Also, see that the glass sediment bowl makes a gasoline-tight contact with the gasket. New valves should be used in rebuilding the fuel pump. Always examine the valve port to see if the brass valve seat is smooth. If not, a lapping tool, Fig. 21, coated with valve-grinding compound will restore the seat. These seats, in many cases, are small brass rings, and can be forced out of the pump casting and replaced. When building up the valve assembly, the parts should go in the order shown in Fig. 22. The composition valves lie flat on the brass seats, the springs bear on the valves and the port plugs are tightened firmly in place. The airdrome type of port plug must always be on the outlet side of the pump to equalize the fuel-pump pressure and to prevent surging.

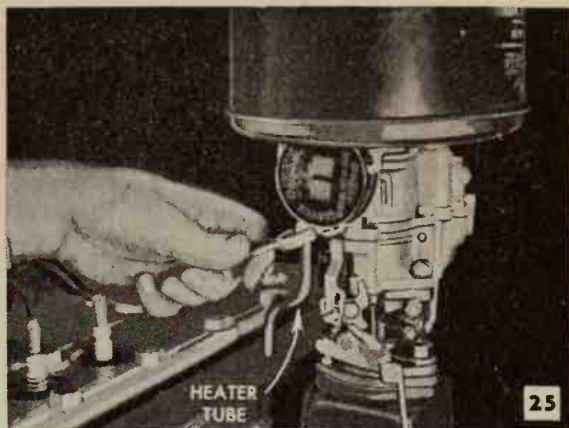
Complete carburetor repair kits are available for the common later types. Carburetor jets can be removed with a screwdriver, but the sides of the blade should be ground as in Fig. 26 so that the threads in



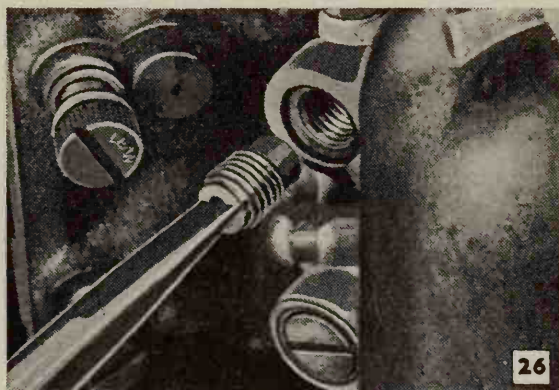
Carburetor-float level, A, is adjusted by bending the float arm. Consult instruction book for dimension

the carburetor bowl will not be damaged. After disassembling, wash all passages and clean the parts with alcohol or acetone to remove any gum deposits. Then blow out the passages with air from a tire pump. Using a jet one size smaller than standard saves fuel. When inserting the leather accelerator plunger, a feeler gauge can be used to help slide this part into place. In Fig. 24, A indicates the float level which is adjustable by bending the float arm. Just how and where the arm is bent, and what the dimension A is, will vary in different cars. Consult instruction data. When assembling the carburetor, all plugs below the gasoline level should have the threads lightly coated with shellac before being installed. With the carburetor installed on the car, the engine should be warmed up thoroughly and the low-speed idle adjustment set so the engine just "ticks" over. The mixture adjustment should be as lean as it can be set without having the engine die or pop back through the carburetor when accelerating. One method of adjusting the length of the accelerating-pump stroke is shown in Fig. 27. With the linkage in position A, pump movement is at a minimum. For more powerful acceleration and cold-weather performance, the linkage is changed to position B.

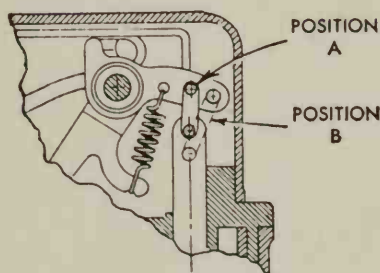
Some types of automatic chokes depend for operation on the heating of a coiled bimetallic spring, Fig. 23, to open and close the choke valve. Sometimes the screen over the end of the heater tube, Fig. 23, becomes clogged and cuts off the flow of heat. This lack of heat causes the valve to be held in a semichoked position, wasting a great amount of fuel. The heater tube, Fig. 25, running from the exhaust manifold to the control should be checked to be sure that it is not clogged. Automatic chokes have a winter and summer setting which should be reset at the end of each season, following manufacturer's directions.



Remove choke-heater tube and blow out with compressed air to make sure it is not clogged with carbon



When removing the carburetor jets, grind the screw-driver blade to prevent damaging the fine threads



Accelerating-pump linkage has two settings, A and B. The former gives best economy with slow acceleration

